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THE ELEMENTS OF STRUCTURAL BOTANY

WITH SPECIAL REFERENCE TO THE STUDY

OF

CANADIAN PLANTS;

TO WHICH IS ADDED

A SELECTION OF EXAMINATION PAPERS.

BY

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HEAD MASTER OF BARRIE COLLEGIATE INSTITUTE.

REVISED EDITION.

With many Illustrations by the Author and others.

W. J. GAGE AND COMPANY,

TORONTO.

PREFACE TO FIRST EDITION.

The work, of which the present little volume forms the first part, has been undertaken, at the suggestion of several eminent educationists, to supply a palpable want. The works on Botany, many of them of great excellence, which have found their way into this country, have been prepared with reference to climates differing, in some cases, very widely from our own. They consequently contain accounts of many plants which are entirely foreign to Canada, thus obstructing the search for descriptions of those which happen to be common to our own and other countries ; and, on the other hand, many of our Canadian species are not mentioned at all in some of the Classifications which have been in use. It is believed that the Classification which is to form the second part of this work will be found to contain all the commonly occurring species of the Provinces whose floras it is designed to illustrate, without being burdened with those which are either extremely rare or which do not occur in Canada at all.

The present part is designed to teach the Elements of Structural Botany in accordance with a method which is believed to be more rational than that commonly adopted; and it will be found to supply all that is requisite for passing the examinations for Teachers' Certificates of all grades, as well as any others demanding an elementary knowledge of the subject. It contains familiar descriptions of common plants, illustrating the chief variations in plant-structure, with a view to laying a foundation for the intelligent study of Systematic Botany with the aid of the second part ; then follow a few lessons on Morphology ; and the Elements of

Vegetable Histology are treated of in as simple and brief a manner as was thought to be consistent with the nature of the subject.

The Schedules, the use of which is very strongly recommended, were devised by the late Professor Henslow, of Cambridge University, to fix the attention of pupils upon the salient points of structure. They will be found invaluable to the teacher as tests of the accuracy of his pupils' knowledge. The cost of striking off a few hundred blanks of each sort would be very trifling, and not worth considering in view of the resulting advantages.

The wood-cuts are from drawings from living specimens, except in two or three instances where assistance was derived from cuts of well-known excellence in standard works on Botany. It need hardly be said that the engravings are not in any sense intended to take the place of the living plants. They are designed chiefly to assist in the examination of the latter; and whilst it is hoped that they may be of service to those who may desire to read the book in the winter season, it is strongly urged upon teachers and students not to be satisfied with them as long as the plants themselves are available.

The works most frequently consulted in the preparation of the text are those of Hooker, Gray, Bentley, and Oliver.

Finally, the Author looks for indulgence at the hands of his fellow-teachers, and will be glad to receive suggestions tending to increase the usefulness of the work, and to extend a taste for what must ever be regarded as one of the most refining as well as one of the most practically useful of studies.

September, 1879.

PREFACE TO REVISED EDITION.

The re-arrangement of the course of study in Botany for Teachers' Certificates and for Junior Matriculation has afforded an opportunity for revising and, it is hoped, improving the present text-book, to which so kind a reception was accorded on its first appearance some years ago.

The principal feature of the new curriculum is the addition of certain Cryptogamous types. These are necessarily somewhat more difficult of study than the Phanerogams, because their characteristics cannot be satisfactorily made out without employing high powers of the microscope; but it is hoped that the numerous illustrations which accompany the text, and which have been gathered from various sources, will materially assist the student in this part of the work.

The chapter relating to minute structure has been re-written, and, as will be seen, considerably extended. Though it is still but a sketch, it is hoped that it will serve a useful purpose in paving the way for the fuller study of the anatomy and physiology of plants with the aid of advanced works.

Other changes and additions have also been made, chiefly in the chapter on Morphology.

The writer need hardly add that in preparing this revision he has laid under contribution the various text-books of recognized merit which have come within his reach, and that beyond the mere presentation of the subject he lays no claim to originality.

Barrie, August, 1887.

TABLE OF COMMON PLANTS EXAMINED.

PHANEROGAMS.

Buttercup, Hepatica, Marsh-Marigold	representing	Ranunculaceæ.
Shepherd's Purse	"	Cruciferæ.
Round-leaved Mallow	"	Malvaceæ.
Garden Pea	"	Leguminosæ.
Great Willow-herb	"	Onagraceæ.
Sweet Brier, Strawberry, Crab-Apple, Cherry, Raspberry	"	Rosaceæ.
Water-Parsnip	"	Umbelliferæ.
Dandelion	"	Compositæ.
Catnip	"	Labiatæ.
Cucumber	"	Cucurbitaceæ.
Oak	"	Cupuliferæ.
Willow	"	Salicaceæ.
Maple	"	Sapindaceæ.
Dog's-tooth Violet	"	Liliaceæ.
Iris	"	Iridaceæ.
Orchis	"	Orchidaceæ.
Indian Turnip, Calla	"	Araceæ.
Timothy, Red-top, Meadow-Grass, Chess, Couch-Grass, Old-witch Grass, Barnyard Grass, Foxtail	"	Gramineæ.
White Pine, Ground Hemlock	"	Coniferæ.

CRYPTOGAMS.

Polypody	representing	Ferns.
Common Club-Moss	"	Lycopods.
Common Horsetail	"	Horsetails.
Hair-Moss	"	Mosses.
Marchantia polymorpha	"	Liverworts.
Parmelia parietina	"	Lichens.
Common Mushroom	"	Mushrooms.
Chara fragilis	"	The Charas.

CONTENTS.

NOTE.

The attention of the student is directed to the following oversights in revision :

In § 277, insert " partly " before " because." The undissolved portion of the grain obviously contains other matter besides starch-cellulose.

In § 307, the statement that carbonic acid gas may be absorbed in solution by roots (given in the first edition on the authority of Oliver) requires modification. It seems to be now well established that the gas is absorbed directly by the leaves, and not by the roots.

THE ELEMENTS

OF

STRUCTURAL BOTANY.

1. The study of Botany is commonly rendered unattractive to the beginner by the order in which the parts of the subject are presented to him. His patience becomes exhausted by the long interval which must necessarily elapse before he is in a position to do any practical work for himself. In accordance with the usual plan, some months are spent in committing to memory a mass of terms descriptive of the various modifications which the organs of plants undergo; and not until the student has mastered these, and perhaps been initiated into the mysteries of the fibro-vascular system, is he permitted to examine a plant as a whole. In this little work, we purpose, following the example of some recent writers, to reverse this order of things, and at the outset to put into the learner's hands some common plants, and to lead him, by his own examination of these, to a knowledge of their various organs—to cultivate, in short, not merely his memory, but also, and chiefly, his powers of observation.

It is desirable that the beginner should provide himself with a magnifying glass of moderate power for examining the more minute parts of specimens; a sharp penknife for dissecting; and a couple of fine needles, which he can himself insert in convenient handles, and which will be found of great service in separating delicate parts, and in impaling fine portions for examination with the aid of the lens.

CHAPTER I.

EXAMINATION OF A BUTTERCUP.

2. To begin with, there is no plant quite so suitable as our common Buttercup. This plant, which has conspicuous yellow flowers, may be found growing in almost every moist meadow. Having found one, take up the whole plant, loosening the soil a little, so as to obtain as much of the Root as possible. Wash away the earth adhering to the latter part, and then proceed to examine your specimen. Beginning with the **Root** (Fig. 1), the first noticeable thing is that it is not of the same colour as the rest of the plant. It is

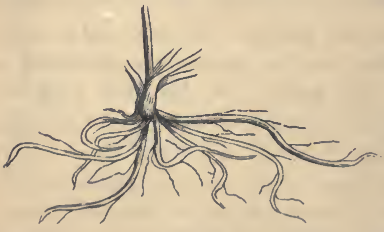

Fig. 1

Fig. 1.—Fibrous Root of Buttercup.

nearly white. Then it is not of the same *form* as the part of the plant above ground. It is made up of a number of thread-like parts which spread out in all directions, and if you examine one of these threads through your magnifying glass, you will find that from its surface are given off many finer threads, called *rootlets.* These latter are of great importance to the plant ; it is largely by means of their tender extremities, and the parts adjacent to these, that it imbibes the nutritious fluids contained in the soil.

Whilst you are looking at these delicate rootlets, you may perhaps wonder that they should be able to make their way through the soil, but how they do this will be apparent to you if you examine the tip of one of them with a microscope of considerable power. Fig. 2 represents such a tip highly magnified. It is to be observed that the growth of the rootlet does not take place at the very extremity, but immediately behind it. The extreme tip consists of harder and firmer matter than that behind, and is in fact a sort of cap or thimble to protect the growing part underneath. As the rootlets grow, this little thimble is pushed on first through the crevices of the soil, and, as you may suppose, is soon worn away on the outside, but it is as rapidly renewed by the rootlet itself on the inside.

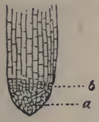

Fig. 2.

Another difference between the root and the part above ground you will scarcely have failed to discover : the root has no leaves, nor has it any buds.

You may describe the root of the Buttercup as *fibrous.*

Fig. 2.—Extremity of rootlet ; *a*, the harder tip ; *b*, the growing portion behind the tip.

Fig. 3.

3. Let us now look at the **Stem** (Fig. 3). It is upright, pretty firm, coloured green, and leaves spring from it at intervals. As there is scarcely any appearance of wood in it, we may describe it as *herbaceous*. At several points along the main stem branches are given off, and you will observe that immediately below the point from which every branch springs there is a leaf on the stem. The angle between the leaf and the stem, on the upper side is called the *axil* of the leaf (*axilla*, an armpit), and it is a rule to which there are scarcely any exceptions, that branches can only spring from the axils of leaves.

The stem and all the branches of our plant terminate, at their upper extremities, either in flowers or in flower-buds.

4. Let us now consider the **Leaves**. A glance will show you that the leaves of this plant are not all alike. Those at the lower end of the stem have long stalks (Fig. 4), which we shall henceforward speak of as *petioles*. Those a little higher up have petioles too, but they are not

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Fig. 3.—Stem of Buttercup.

quite so long as the lower ones, and the highest leaves have no petioles at all. They appear to be sitting on the stem, and hence are said to be *sessile*. The lowest

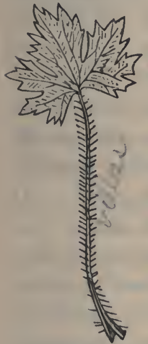

Fig. 4.

leaves of all, as they seem to spring from the root, may be described as *radical*, whilst the higher ones may be called *cauline* (*caulis*, a stem). The broad part of a leaf is its *blade*. In the plant we are now examining, the blades of the leaves are almost divided into distinct pieces, which are called *lobes*, and each of these again is more or less deeply *cut*. Both petioles and blades of our leaves are covered with minute hairs, and so are said to be *hairy*.

Hold up one of these leaves to the light, and you will observe that the veins run through it in all directions, forming a sort of net-work. The leaves are therefore *net-veined*.

The points along the stem from which the leaves arise are called *nodes*, and the portions of stem between the nodes are called *internodes*.

5. Let us next examine the **Flowers**. Each flower in our plant is at the end either of the stem or of a branch of the stem. The upper portions of the stem and its branches, upon which the flowers are raised, are called the *peduncles* of the flowers.

Fig. 5.

Take now a flower which has just opened. Beginning at the outside, you will find five little spreading leaves, somewhat yellowish

Fig. 4.—Radical leaf of Buttercup.
Fig. 5.—Flower of Buttercup, from the back.

in colour. Each of these is called a *sepal*, and the five together form the **calyx** of the flower. If you look at a flower which is a little older, you will probably not find any sepals. They will have fallen off, and for this reason they are said to be *deciduous*. So, in like manner, the leaves of most of our trees are deciduous, because they fall at the approach of winter. You will find that you can pull off the sepals one at a time, without disturbing those that remain. This shows that they are not connected together. They are therefore said to be *free*, and the calyx is described as *polysepalous*.

Inside the circle of sepals there is another circle of leaves, usually five in number, bright yellow in colour, and much larger than the sepals. Each of them is called a *petal*, and the five together form the **corolla** of the flower. Observe carefully that each petal is not inserted in front of a sepal, but in front of the space between two sepals. The petals can be removed one at a time like the sepals. They, too, are free, and the corolla is *polypetalous*. If you compare the petals with one another, you will see that they are, as nearly as possible, alike in size and shape. The corolla is therefore *regular*.

6. We have now examined, minutely enough for our present purpose, the calyx and corolla. Though their divisions are not coloured green, like the ordinary leaves of the plant, still, from their general form, you will have no difficulty in accepting the statement that the sepals and petals are in reality *leaves*. It will not be quite so apparent that the parts of the flower which still remain are also only modifications of the same structure. But there is good evidence that this is the case. Let us, however, examine these parts that remain. There is

first a large number of little yellow bodies, each at the

Fig. 6.

top of a little thread-like stalk. Each of these bodies, with its stalk, is called a **stamen**. The little body itself is the *anther*, and the stalk is its *filament*. Your magnifying glass will show you that each anther consists of two oblong sacs, united lengthwise, the filament being a continuation of the line of union (Fig. 7).

Fig. 7.

Fig. 8.

If you look at a stamen of a flower which has been open some time, you will find that each anther-cell has split open along its outer edge, and has thus allowed a fine yellowish dust to escape from it (Fig. 8). This dust is called *pollen*. A powerful magnifier will show this pollen to consist of grains having a distinct form.

As the stamens are many in number, and free from each other, they are said to be *polyandrous*.

Fig. 9.

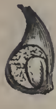

Fig. 10.

7. On removing the stamens there is still left a little raised mass (Fig. 9), which, with the aid of your needle, you will be able to separate into a number of distinct pieces, all exactly alike, and looking something like unripe seeds. Fig. 10 shows one of them very much magnified, and cut through lengthwise. These little bodies, taken separately, are called *carpels*. Taken together, they form the **pistil**. They are hollow, and each of them contains, as the figure shows, a

Fig. 6.—Section of a flower of Buttercup.

Fig. 7.—Stamen of Buttercup.

Fig. 8.—The same, showing longitudinal opening of the anther.

Fig. 9.—Head of carpels of Buttercup.

Fig. 10.—A single carpel cut through lengthwise to show the ovule.

little grain-like substance attached to the lower end of its cavity. This substance, in its present condition, is the *ovule*, and later on becomes the *seed.*

You will notice that the carpel ends, at the top, in a little bent point, and that the convex edge is more or less rough and moist, so that in flowers whose anthers have burst open, a quantity of pollen will be found sticking there. This rough upper part of the carpel is called the *stigma.* Fig. 11 shows a stigma greatly magnified. In many plants the stigma is raised on a stalk above the ovary. Such a stalk is called a *style.* In the Buttercup the style is so short as to be almost suppressed. When the style is entirely absent, the stigma is said to be sessile. The hollow part of the carpel is the *ovary.*

Fig. 11.

In our plant the pistil is not connected in any way with the calyx, and is consequently said to be *free* or *superior*, and, as the carpels are not united together, the pistil is said to be *apocarpous.*

Fig. 12.

8. Remove now all the carpels, and there remains nothing but the swollen top of the peduncle. This swollen top is the *receptacle* of the flower. To it, in the case of the Buttercup, all four parts, calyx, corolla, stamens, and pistil, are attached. When a flower has all four of these parts it is said to be *complete.*

9. Let us now return to our statement that the structure of stamens and pistils is only a modification of leaf-structure generally. The stamen

Fig. 11.—Stigma of Buttercup with adhering pollen-grains; highly magnified.
Fig. 12.—Diagram to show leaf-structure of a stamen.

looks less like a leaf than any other part of the flower. Fig. 12 will, however, serve to show us the plan upon which the botanist considers a stamen to be formed. The anther corresponds to the leaf-blade, and the filament to the petiole. The two cells of the anther correspond to the two halves of the leaf, and the cells burst open along what answers to the margin of the leaf.

10. In the case of apocarpous pistils, as that of the Buttercup, the botanist considers each carpel to be formed by a leaf-blade doubled lengthwise until the edges meet and unite, thus forming the ovary. Fig. 13 will make this clear.

11. There are many facts which support this theory as to the nature of the different parts of the flower. Suffice it to mention here, that in the white Water-Lily, in which there are several circles of sepals and petals, it is difficult to say where the sepals end and the petals begin, on account of the gradual change from one set to the other. And not only is there a gradual transition from sepals to petals, but there is likewise a similar transition from petals to stamens, some parts occurring which are neither altogether petals, nor altogether stamens, but a mixture of both, being imperfect petals with imperfect anthers at their summits. We can thus trace ordinary leaf-forms, by gradual changes, to stamens.

Fig. 13.

We shall then distinguish the leaves of plants as *foliage-leaves* and *flower-leaves*, giving the latter name exclusively to the parts which make up the flower, and the former to the ordinary leaves which grow upon the stem and its branches.

Fig. 13.—Diagram to illustrate the leaf-structure of the carpel.

12. You are now to try and procure a Buttercup whose flowers, or some of them, have withered away, leaving only the head of carpels on the receptacle. The carpels will have swollen considerably, and will now show themselves much more distinctly than in the flower which we have been examining. This is owing to the growth of the ovules, which have now become seeds. Remove one of the carpels, and carefully cut it through the middle lengthwise. You will find that the seed almost entirely fills the cavity. (Figs. 14 and 15.)

Fig. 14.

Fig. 15.

This seed consists mainly of a hard substance called *albumen*, enclosed in a thin covering. At the lower end of the albumen is situated a very small body, which is the *embryo*. It is this which developes into a new plant when the seed germinates.

Fig. 16.

13. We have seen, then, that our plant consists of several parts:

(1). **The Root.** This penetrates the soil, avoiding the light. It is nearly white, is made up of fibres, from which numbers of much finer fibres are given off, and is entirely destitute of buds and leaves.

(2). **The Stem.** This grows upward, is coloured, bears foliage-leaves at intervals, gives off branches from the axils of these, and bears flowers at its upper end.

(3). **The Leaves.** These are of two sorts: *Foliage-leaves* and *Flower-leaves.* The former are sub-divided

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Fig. 14.—Ripe carpel of Buttercup.

Fig. 15.—Section of same.

Fig. 16.—Section of seed showing the small embryo. All much magnified.

into *radical* and *cauline*, and the latter make up the flower, the parts of which are four in number, viz.: **calyx, corolla, stamens,** and **pistil.**

It is of great importance that you should make yourselves thoroughly familiar with the different parts of the plant, as just described, before going further, and to that end it will be desirable for you to review the present chapter carefully, giving special attention to those parts which were not perfectly plain to you on your first reading.

In the next chapter, we shall give a very brief account of the *uses* of the different parts of the flower. If found too difficult, the study of it may be deferred until further progress has been made in plant-examination.

CHAPTER II.

FUNCTIONS OF THE ORGANS OF THE FLOWER.

14. The chief use of the calyx and corolla, or *floral envelopes*, as they are collectively called, is *to protect the other parts of the flower.* They enclose the stamens and pistil in the bud, and they usually wither away and disappear shortly after the anthers have shed their pollen, that is, as we shall presently see, as soon as their services as protectors are no longer required.

15. The corollas of flowers are usually bright-coloured, and frequently sweet-scented. There is little doubt that these qualities serve to attract insects, which, in search

of honey, visit blossom after blossom, and, bringing their hairy limbs and bodies into contact with the open cells of the anthers, detach and carry away quantities of pollen, some of which is sure to be rubbed off upon the stigmas of other flowers of the same kind, subsequently visited.

16. The essential part of the stamen is the anther, and the purpose of this organ is to produce the pollen, which, as you have already learned, consists of minute *grains*, having a definite structure. These little grains are usually alike in plants of the same kind. They are furnished with two coats, the inner one extremely thin, and the outer one much thicker by comparison. The interior of the pollen-grain is filled with liquid matter. When a pollen-grain falls upon the moist stigma it *begins to grow* in a curious manner (Fig. 17). The inner coat pushes its way through the outer one, at some weak point in the latter, thus forming the beginning of a slender tube. This slowly penetrates the stigma, and then extends itself downwards through the style, until it comes to the cavity of the ovary. The liquid contents of the pollen-grain are carried down through this tube, which remains closed at its lower end, and the body of the grain on the stigma withers away.

Fig. 17.

The ovary contains an ovule, which is attached by one end to the wall of the ovary. The ovule consists of a kernel, called the *nucleus*, which is usually surrounded by two coats, through both of which there is a minute opening to the nucleus. This opening is called the *micropyle*, and is

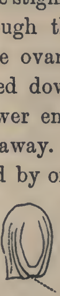


Fig 18.

Fig. 17.—Pollen-grain developing a tube.
Fig. 18 —Section of an ovule, showing central nucleus coats, and micropyle.

always to be found at that end of the ovule which is not attached to the ovary. (Fig. 18, *m.*)

About the time the anthers discharge their pollen, a little cavity, called the *embryo-sac*, appears inside the nucleus, near the micropyle. The pollen-tube, with its liquid contents, enters the ovary, passes through the micropyle, penetrates the nucleus, and attaches itself to the outer surface of the embryo-sac. Presently the tube becomes empty, and then withers away, and, in the meanwhile, a minute body, which in time developes into the embryo, makes its appearance in the embryo-sac, and from that time the ovule may properly be called a seed.

17. In order that ovules may become seeds, it is always essential that they should be *fertilized* in the manner just described. If we prevent pollen from reaching the stigma —by destroying the stamens, for instance—the ovules simply shrivel up and come to nothing.

Now it is the business of the flower to produce seed, and we have seen that the production of seed depends mainly upon the stamens and the pistil. These organs may consequently be called the *essential organs* of the flower. As the calyx and corolla do not play any *direct* part in the production of seed, but only protect the essential organs, and perhaps attract insects, we can understand how it is that they, as a rule, disappear early. Their work is done when fertilization has been accomplished.

Having noticed thus briefly the part played by each set of floral organs, we shall now proceed to the examination of two other plants, with a view to comparing their structure with that of the Buttercup.

CHAPTER III.

EXAMINATION OF HEPATICA AND MARSH-MARIGOLD—RESEMBLANCES BETWEEN THEIR FLOWERS AND THAT OF BUTTERCUP.

18. **Hepatica.** You may procure specimens of the Hepatica almost anywhere in rich dry woods, but you will not find it in flower except in spring and early summer. It is very desirable that you should have the

Fig. 19.

plant itself, but for those who are unable to obtain specimens, the annexed engravings may serve as a substitute.

Fig. 19.—Anemone Hepatica.

Beginning, then, at the root of our new plant, you see that it does not differ in any great measure from that of the Buttercup. It may, in like manner, be described as *fibrous.*

The next point is the stem. You will remember that in the Buttercup the stem is that part of the plant from which the leaves spring. Examining our Hepatica in the light of this fact, and following the petioles of the leaves down to their insertion, we find that they and the roots appear to spring from the same place—that there is, apparently, *no stem.* Plants of this kind are therefore called *acaulescent*, that is, *stemless*, but it must be carefully borne in mind that the absence of the stem is only apparent. In reality there is a stem, but it is so short as to be almost indistinguishable.

The leaves of the Hepatica are, of course, all *radical.* They will also be found to be *net-veined.*

19. The **Flowers** of the Hepatica are all upon long peduncles, which, like the leaves, appear to spring from the root. Naked peduncles of this kind, rising from the ground or near it, are called *scapes.* The flower-stalks of the Tulip and the Dandelion furnish other familiar examples.

Let us now proceed to examine the flower itself. Just beneath the coloured leaves there are three leaflets, which you will be almost certain to regard, at first sight, as sepals, forming a calyx. It will not be difficult, however, to convince you that this conclusion would be incorrect. If, with the aid of your needle, you turn back these leaflets, you will readily discover, between them and the coloured portion of the flower, *a very short bit of stem* (Fig. 20), the upper end of which is the *receptacle.* As these leaflets, then, are on the peduncle, *below* the receptacle, they cannot be sepals. They are simply small foliage leaves, to which, as they are found beside the flower, the name *bracts* is given. Our flower, then, is apparently without a calyx, and in this respect is different from the Buttercup. The whole four parts of the flower not being present, it is said to be *incomplete*.


Fig. 20.

20. It may be explained here that there is an understanding among botanists, that if the calyx and corolla are not both present it is always the corolla which is wanting, and so it happens that the coloured part of the flower under consideration, though resembling a corolla, must be regarded as a calyx, and the flower itself, therefore, as *apetalous*.

21. Remove now these coloured sepals, and what is left of the flower very much resembles what was left of our Buttercup, after the removal of the calyx and corolla. The stamens are very numerous, and are inserted on the receptacle. The carpels are also numerous (Fig. 21), are inserted on the receptacle, and are free from each other (*apocarpous*). And if you examine one of the carpels (Fig. 22) you will find that it contains a single ovule. The flower, in short, so much resembles that of the Buttercup that you will be prepared to learn that the two belong to the same Order or Family of plants, and you will do well to observe and remember such resemblances as have just been brought to your notice, when you set out to examine plants for your


Fig. 21.


Fig. 22.

Fig. 20.—Flower of Hepatica, with bracts below.
Fig. 21.—Carpels of Hepatica. Fig. 22.—Single carpel, enlarged.

selves, because it is only in this way, and by slow steps, that you can acquire a satisfactory knowledge of the reasons which lie at the foundation of the classification of plants.

22. **Marsh-Marigold.** This plant grows in wet places almost everywhere, and is in flower in early summer.

Note the entire absence of hairs on the surface of the plant. It is therefore *glabrous.*

The root, like that of the Buttercup and of the Hepatica, is *fibrous.*

The stem is hollow and furrowed.

The foliage-leaves are of two kinds, as in the Buttercup. The radical leaves spring from the base of the stem, whilst the higher ones are cauline. The leaves are not lobed, as in the other two plants, but are indented on the edge. They are also net-veined.

23. Coming to the flower (Fig. 23) we find a circle, or whorl, of bright yellow leaves, looking a good deal like the petals of the Buttercup, but you will look in vain for the corresponding sepals. In this case there is no whorl of bracts to mislead you. Are we to say, then, that there is no calyx? If we adhere to the understanding mentioned when describing the Hepatica, we must suppose the *corolla* to be wanting, and then the bright yellow leaves of our plant will be the *sepals,* and will together constitute the calyx. As to the number of the sepals, you will find, as in the

Fig. 23.

Fig. 23.—Flower and leaf of Marsh-Marigold.

Hepatica, some variation. Whilst the normal number is five, some flowers will be found to have as many as nine.

24. The stamens are next to be examined, but you should first satisfy yourselves as to whether the calyx is polysepalous or otherwise, and whether it is free from the other floral leaves or not. If your examination be properly made, it will show you that the calyx is free and polysepalous.

The stamens are very much like those of the Buttercup and Hepatica. They are numerous, they have both anthers and filaments, and they shed their pollen through slits on the outer edges of the anthers. They are all separate from each other (polyandrous), and are all inserted on the receptacle. On this latter account they are said to *hypogynous* (below the pistil).

25. Remove the stamens, and you have left, as before, a head of carpels (Fig. 24). Examine one: there is the lower broad part, which you recognize as the *ovary*, the very short style, and the sticky stigma. To all appearance the carpels are pretty much the same as those of the two plants already examined. It will not do, however, to trust altogether to appearances in this case. Cut open a carpel and you find that, instead of a single ovule at the bottom of the ovary, there are several ovules in a row along that edge of the ovary which is turned towards the centre of the flower. The ovary is, in fact, a *pod*, and, when the seeds ripen, splits open along its inner edge. If you can find one which has split in this way, you can hardly fail to be struck with the resemblance which it bears to a common leaf. (Fig. 25.)

Fig. 24.

Fig. 25.

Fig. 24.—Head of carpels of Marsh-Marigold.

Fig. 25.—Single carpel, opened to show the two rows of seeds.

On the whole the resemblance between the structure of the Marsh-Marigold and that of the Hepatica and Buttercup is sufficiently great to justify us in placing it in the same family with them.

26. Having now made yourselves familiar with the different parts of these three plants, you are to write out a tabular description of them according to the following form; and, in like manner, whenever you examine a new plant, do not consider your work done until you have written out such a description of it.

BUTTERCUP.

ORGAN OR PART OF FLOWER.	NO.	COHESION.	ADHESION.	REMARKS.
Calyx. *Sepals.*	5	Polysepalous.	Inferior.	
Corolla. *Petals.*	5	Polypetalous.	Hypogynous.	Each Petal with a pit at the base inside
Stamens. *Filaments.* *Anthers.*	∞	Polyandrous.	Hypogynous.	
Pistil. *Carpels.* *Ovary.*	∞	Apocarpous.	Superior.	Carpels 1-seeded.

In the form the term *cohesion* relates to the union of *like* parts; for example, of sepals with sepals, or petals with petals; while the term *adhesion* relates to the union of *unlike* parts; for example, of stamens with corolla, or ovary with calyx. Neither cohesion nor adhesion takes place in any of the three flowers we have examined, and accordingly, under these headings in our schedule we write down the terms polysepalous, polypetalous, &c., to indicate this fact.

HEPATICA.

ORGAN.	NO.	COHESION.	ADHESION.	REMARKS.
Calyx. *Sepals.*	7-12	Polysepalous.	Inferior.	Coloured like a corolla.
Corolla. *Petals.*				Wanting.
Stamens. *Filaments.* *Anthers.*	∞	Polyandrous.	Hypogynous.	
Pistil. *Carpels.* *Ovary.*	∞	Apocarpous.	Superior.	Carpels 1-seeded.

MARSH-MARIGOLD.

ORGAN.	NO.	COHESION.	ADHESION.	REMARKS.
Calyx. *Sepals.*	5-9	Polysepalous.	Inferior.	Coloured like a corolla.
Corolla. *Petals.*				Wanting.
Stamens. *Filaments.* *Anthers.*	∞	Polyandrous.	Hypogynous.	
Pistil. *Carpels.* *Ovary.*	∞	Apocarpous.	Superior.	Carpels contain several seeds.

Virgin's Bower, Meadow Rue, Anemone

The symbol ∞ means "indefinite," or "numerous," and may be used when the parts of any organ exceed ten in number.

Under the head "Remarks" you may describe anything worthy of notice, for which provision is not made elsewhere in the schedule.

If you use the exercise-book which has been prepared to accompany the text-book, you will find also space for *drawing* such parts as are not easy to describe in words.

27. The three plants upon which we have been engaged up to this point are representatives or *types* of a very large group, called by botanists *Ranunculaceæ*, that is, *Ranunculaceous plants*. All the members of it, whilst they may differ in certain minor characteristics, agree in all the more important respects. The minor differences, such as we have observed in our examination of the specimens, lead to the sub-division of the group into several smaller groups, but any plant exhibiting the peculiarities common to all three may be regarded as typical of the *Order*, which is the name given to the group as a whole. These common peculiarities may be summed up with sufficient accuracy for our present purpose, as follows :

1. *The circles of flower-leaves, that is to say, the sepals, petals, stamens, and carpels, are entirely distinct, and unconnected with each other.*
2. *The several members of each circle are also entirely separate from each other.*
3. *It may be added that the stamens are almost invariably numerous, and that the plants are acrid to the taste*

CHAPTER IV.

EXAMINATION OF OTHER COMMON PLANTS WITH HYPOGYNOUS STAMENS—SHEPHERD'S PURSE—ROUND-LEAVED MALLOW.

28. We shall now proceed to examine some plants, the flowers of which exhibit, in their structure, important variations from the Buttercup, Hepatica, and Marsh-Marigold.

Shepherd's Purse. This plant (Fig. 26) is one of the commonest of weeds. As in the Buttercup, the foliage-leaves are of two kinds, radical and cauline, the former being in a cluster around the base of the stem. The cauline leaves are all sessile, and each of them, at its base, projects backward on each side of the stem, so that the leaf somewhat resembles the head of an arrow. Such leaves are, in fact, said to be *sagittate*, or arrow-shaped. The flowers grow in a cluster at the top of the stem, and, as the season advances, the peduncle gradually elongates, until, at the close of the summer, it forms perhaps half of the entire length of the stem. You will observe in this plant, that each separate flower is raised on a little stalk of its own. Each of these little stalks is a *pedicel*, and when pedicels are present, the term peduncle is applied to the portion of stem which supports the whole cluster.

Fig. 27.

29. The flowers (Fig. 27) are rather small, and so will require more than ordinary care in their examination. The calyx is polysepalous, and of

Fig. 27.—Flower of Shepherd's Purse, enlarged.

Fig. 26.--Shepherd's Purse.

four sepals. The corolla is polypetalous, and of four petals. The stamens (Fig. 28) are six in number, and if you examine them attentively, you will see that two of them are shorter than the other four The stamens are consequently said to be *tetradynamous.* But if there had been only *four* stamens, in two sets of two each, they would have been called *didynamous.* The stamens are inserted on the receptacle (hypogynous). The pistil is separate from the other parts of the flower (superior).

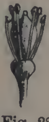


Fig. 28.

30. To examine the ovary, it will be better to select a ripening pistil from the lower part of the peduncle. It is a flat body, shaped something like a heart (Fig. 29), and having the short style in the notch. A ridge divides it lengthwise on each side. Carefully cut or pull away the lobes, and this ridge will remain, presenting now the appearance of a narrow loop, with a very thin membranous partition stretched across it. Around the edge, on both sides of the partition, seeds are suspended from slender stalks (Fig. 30). There are, then, *two carpels united together*, and the pistil is, therefore, *syncarpous.*

Fig. 29.

Fig. 30.

31. Shepherd's Purse is a type of a large and important Order, the *Cruciferæ*, or Cress Family. Other common examples, which should be studied and compared with Shepherd's Purse, are the garden Stock (*single* flowers are best for examination), Water-Cress, the yellow Mustard

Fig. 28.—The same, with calyx and corolla removed.

Fig. 29.—Ripened pistil of Shepherd's Purse.

Fig. 30.—The same, with one side removed to show the seeds.

of the wheat-fields, Radish, Sweet Alyssum of the gardens, &c. All these plants, while differing in unimportant particulars, such as the colour and size of the petals and the shape of the pod, agree in presenting the following characters:

1. *The sepals and petals are each four in number.*
2. *The stamens are tetradynamous (and hypogynous).*
3. *The fruit is syncarpous, and is 2-celled by reason of a thin partition stretched between the carpels.*
4. *It may be added that the plants are generally pungent to the taste, and the flowers are almost invariably in terminal clusters, like that of Shepherd's Purse.*

SHEPHERD'S PURSE.

ORGAN.	NO.	COHESION.	ADHESION.	REMARKS.
Calyx. *Sepals.*	4	Polysepalous.	Inferior.	
Corolla. *Petals.*	4	Polypetalous.	Hypogynous.	
Stamens. *Filaments.* *Anthers.*	6	Tetradynamous.	Hypogynous.	Two sepals with a pair of long stamens opposite each; the other two with one short stamen opp. each.
Pistil. *Carpels.* *Ovary.*	2	Syncarpous.	Superior.	The two cells of the ovary separated by a thin partition.

32. Mallow. The round-leaved Mallow (Fig. 31) grows along every wayside, and is a very common weed in cultivated grounds. Procure, if possible, a plant which has ripened its seeds, as well as one in flower. The root of this plant is of of a different kind from those of the three plants first examined. It consists of a stout tapering part, descending deep into the soil, from the surface of which fibres are given off irregularly. A stout root of this kind is called a *tap-root.* The carrot is another example.

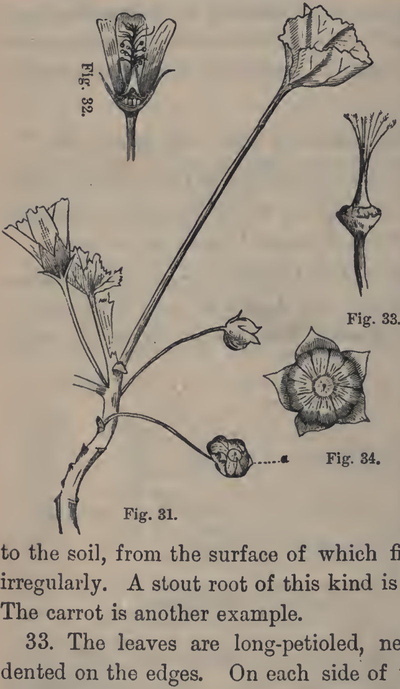


Fig. 32.

Fig. 31.

Fig. 33.

Fig. 34.

33. The leaves are long-petioled, net-veined, and indented on the edges. On each side of the petiole, at its junction with the stem, you will observe a little leaf-like attachment, to which the name *stipule* is given. The presence or absence of stipules is a point of some importance in plant-structure, and you will do well to notice it in your examinations. You have now made yourselves

Fig. 31.—Round-leaved Mallow. Fig. 32.—Section of the flower.
Fig. 33.—Flower with calyx and corolla removed.
Fig. 34.—A ripened pistil with the persistent calyx.

acquainted with all the parts that any leaf has, viz., *blade*, *petiole*, and *stipules*.

34. Coming to the flower, observe first that the parts of the calyx are not entirely separate, as in the flowers you have already examined. For about half their length they are united together so as to form a cup. The upper half of each sepal, however, is perfectly distinct, and forms a *tooth* of the calyx ; and the fact that there are five of these teeth shows us unmistakably that the calyx is made up of five sepals. We therefore speak of it as a *gamosepalous* calyx, to indicate that the parts of it are coherent.

As the calyx does not fall away when the other parts of the flower disappear, it is said to be *persistent*. Fig. 31, *a*, shows a persistent calyx.

35. At the base of the calyx there are three minute leaf-like teeth, looking almost like an outer calyx. A circle of bracts of this kind is called an *involucre*. The three bracts under the flower of the Hepatica also constitute an involucre. As the bracts in the Mallow grow on the calyx, some botanists speak of them as an *epicalyx*.

The corolla consists of five petals, separate from each other, but united with the stamens at their base.

36. The stamens are numerous, and as their filaments are united to form a tube, they are said to be *monadelphous*. This tube *springs from the receptacle*, and the stamens are therefore *hypogynous*. Fig. 32 will help you to an understanding of the relation between the petals and stamens.

Having removed the petals, split the tube of the stamens with the point of your needle. A little care will then enable you to remove the stamens without injuring the pistil. The latter organ will then be found to consist of a ring of coherent carpels, a rather stout style, and numerous long stigmas (Fig. 33). If you take the trouble to count the carpels and the stigmas, you will find the numbers to correspond. As the seeds ripen, the carpels separate from each other (Fig. 34).

MALLOW.

Organ.	No.	Cohesion.	Adesion.	Remarks.
Calyx. *Sepals.*	5	Gamosepalous.	Inferior.	Three bracts growing on the calyx.
Corolla. *Petals.*	5	Polypetalous.	Hypogynous.	
Stamens. *Filaments.* *Anthers.*	∞	Monadelphous One-celled.	Hypogynous.	
Pistil. *Carpels.* *Ovary.*	∞	Syncarpous.	Superior.	Carpels as many as the stigmas.

37. Compare now the structure of the Hollyhock (single flowers should be selected) with that of the Mallow, and write out a description. Musk-Mallow and Abutilon (a common green-house plant) may also be examined with advantage.

38. The Order *(Malvaceæ)* of which Mallow is a type is very distinctly marked by the following characteristics:

1. *The sepals are always placed edge to edge* (*valvate*) *in the bud, while the petals overlap and are rolled together* (*convolute*).
2. *The stamens are numerous and monadelphous, and their anthers are 1-celled. Although united at the*

base with the claws of the petals, they are nevertheless inserted on the receptacle (hypogynous).

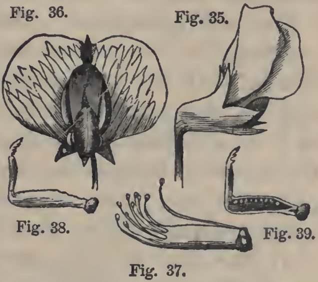
3. *The carpels are almost always united in a ring, which breaks up at maturity.*

4. *It may be added that the leaves are furnished with stipules, and the juice of the plants is mucilaginous.*

CHAPTER V.

EXAMINATION OF COMMON PLANTS WITH PERIGYNOUS STAMENS—GARDEN PEA—GREAT WILLOW-HERB.

39. **Garden Pea.** In the flower of this plant, the calyx is constructed on the same plan as in the Mallow. There are five sepals, coherent below, and spreading out into distinct teeth above (Fig. 35). The calyx is therefore gamosepalous.



Examine next the form of the corolla (Fig. 36). One difference between the corolla and those of the previous plants will strike you at once. In the flowers of the latter you will remember that each petal was precisely like its fellows in size and shape, and we therefore spoke of the corolla as *regular*. In the Pea, on the other hand,

Fig. 35.—Flower of Garden Pea. Fig. 36.—Front view of the same.
Fig. 37.—Diadelphous stamens of the same.
Fig. 38.—The pistil. Fig. 39.—The same cut through lengthwise.

one of the petals is large, broad, and open, whilst two smaller ones, in the front of the flower, are united into a kind of hood. We shall speak of this corolla, then, and all others in which the petals are unlike each other in size or shape, as *irregular.*

As the Pea blossom bears some resemblance to a butterfly, it is said to be *papilionaceous.*

40. Remove now the calyx-teeth and the petals, being very careful not to injure the stamens and the pistil, enveloped by those two which form the hood. Count the stamens, and notice their form (Fig. 37). You will find ten, one by itself, and the other nine with the lower halves of their filaments joined together, or coherent. When stamens occur in this way, in two distinct groups, they are said to be *diadelphous* ; if in three groups, they would be *triadelphous* ; if in several groups, *polyadelphous.* In the Mallow, you will remember, they are united into *one* group, and therefore we described them as *monadelphous.*

You will, perhaps, be a little puzzled in trying to determine to what part of the flower the stamens are attached. If you look closely, however, you will see that the attachment, or *insertion,* is not quite the same as in the Buttercup and the other flowers examined. In the present instance they are inserted upon the lower part of the calyx, and so they are described as *perigynous,* a term meaning "around the pistil."

41. But the pistil (Figs. 38, 39) is not attached to the calyx. It is *free,* or *superior.* If you cut the ovary across, you will observe there is but one cell, and if you examine the stigma, you will find that it shows no sign of division. You may therefore be certain that the pistil is a single carpel.

You are now prepared to fill up the schedule descriptive of this flower.

GARDEN PEA.

ORGAN.	NO.	COHESION.	ADHESION.	REMARKS.
Calyx. *Sepals.*	5	Gamosepalous	Inferior.	
Corolla. *Petals.*	5	Papilionaceous. Irregular.	Perigynous.	The two front petals united.
Stamens. *Filaments.* *Anthers.*	10	Diadelphous.	Perigynous.	
Pistil. *Carpels.* *Ovary.*	1	Apocarpous.	Superior.	

42. The beginner will be very likely to think, from its appearance, that the largest of the petals is made up of two coherent ones, but the following considerations show clearly that this is not the case. In the Buttercup, and other flowers in which the number of sepals and petals is the same, the petals do not stand before the sepals, but before the spaces between them. In the Pea-blossom this rule holds good if the large petal is considered as one, but not otherwise. Again, the veining of this petal is similar to that of a common leaf, there being a central rib from which the veins spring on each side; and lastly, there are some flowers of the Pea kind—Cassia, for example—in which this particular petal is of nearly the same size and shape as the other four.

43. The Pea is a type of a highly important group of plants—the Order *Leguminosæ*. To it belong many plants

differing very widely in external appearance—the Locust-Tree and the Clover, for example—but exhibiting in the structure of their flowers so marked a similarity that their relationship is beyond question. The characters by which the Order is distinguished are chiefly these:

1. *The corolla is more or less papilionaceous, and is inserted on the base of the calyx (perigynous).*
2. *The stamens, almost invariably ten in number, are also perigynous, and nearly always diadelphous.*
3. *The pistil is nearly always a legume, that is to say, it is a single carpel which splits into two pieces at maturity, like the pod of the Pea or Bean.*
4. *The leaves have stipules, and are nearly always compound, that is, of several distinct leaflets.*

Plants which may be compared with the Pea are Red Clover, White Clover, Sweet Clover, Medick, Locust-Tree, Bean, Vetch, Lupine, Sweet Pea, &c. Tick Trefoil

44. **Great Willow-herb.** This plant is extremely common in low grounds and newly-cleared land, and you may easily recognize it by its tall stem and bright purple flowers.

Fig. 40.

Observe the position of the flowers. In the three plants first examined we found the flowers at the end of the stem. In the Willow-herb, as in the Mallow, they spring from the sides of the stem, and immediately below the point from which each flower springs you will find a small leaf or bract (Fig. 40). Flowers

Fig. 40.—Flower of Great Willow-herb.

which arise from the axils of bracts are said to be *axillary*, whilst those which are at the ends of stems are called *terminal*, and you may remember that flowers can only be produced in the axils of leaves and at the ends of stems and branches.

45. Coming to the flower itself, direct your attention, first of all, to the position of the ovary. You will find it apparently under the flower, in the form of a tube tinged with purple. It is not in reality under the flower, because its purplish covering is the calyx, or, more accurately, the *calyx-tube*, which adheres to the whole surface of the ovary, and expands above into four long teeth. The ovary, therefore, is *inferior*, and the calyx, of course, *superior*, in this flower. As the sepals unite below to form the tube the calyx is gamosepalous.

The corolla consists of four petals, free from each other, and is consequently polypetalous. It is also regular, the petals being alike in size and shape. Each petal is narrowed at the base into what is called the *claw* of the petal, the broad part, as in the ordinary foliage-leaf, being the *blade*. The stamens are eight in number (octandrous), four short and four long, and are attached to the calyx (perigynous).

Fig. 42.

Fig. 41.

46. The pistil has its three parts—ovary, style, and stigma—very distinctly marked. The stigma consists of four long lobes, which curl outwards after the flower opens. The

Fig. 41.—Ripened pistil of Willow-herb. Fig. 42.—Cross section of the same.

style is long and slender. The examination of the ovary requires much care; you will get the best idea of its structure by taking one which has just burst open and begun to discharge its seeds (Fig. 41). The outside will then be seen to consist of four pieces (*valves*), whilst the centre is occupied by a slender four-winged column (Fig. 42), in the grooves of which the seeds are compactly arranged. The pistil thus consists of four carpels united together, and is therefore *syncarpous*. Every seed is furnished with a tuft of silky hairs, which greatly facilitates its transportation by the wind.

47. The Willow-herb furnishes an excellent example of what is called *symmetry*. We have seen that the calyx and corolla are each made up of four parts; the stamens are in two sets of four each; the stigma is four-lobed, and the ovary has four seed-cells. A flower is *symmetrical* when each set of floral leaves contains either the same number of parts or a *multiple* of the same number.

Observe that the leaves of our plant are net-veined.

The schedule will be filled up as follows:

GREAT WILLOW-HERB.

ORGAN.	NO.	COHESION.	ADHESION.	REMARKS.
Calyx. *Sepals.*	4	Gamosepalous	Superior.	
Corolla. *Petals.*	4	Polypetalous.	Perigynous.	
Stamens. *Filaments.* *Anthers.*	8	Octandrous.	Perigynous.	Four short and four long.
Pistil. *Carpels.* *Ovary.*	4	Syncarpous.	Inferior.	Seeds provided with tufts of hair.

Flowers to compare with Great Willow-herb are Fuchsia and Evening Primrose. Either of these will serve as the type if Willow-herb cannot be obtained.

CHAPTER VI.

EXAMINATION OF COMMON ROSACEOUS PLANTS—SWEET BRIER —STRAWBERRY—CHERRY—CRAB-APPLE—RASPBERRY.

48. **Sweet Brier.** As in the flowers examined in the last chapter, the sepals of Sweet Brier are not entirely distinct; their lower halves cohere to form a tube, and the calyx is therefore gamosepalous.

Fig. 43.

The corolla consists of five separate petals of the same size and shape, and is therefore both regular and polypetalous.

The stamens are very numerous, and separate from each other. As in the Pea and the Willow-herb, so in this flower they will be

Fig. 43.—Flower and leaves of Sweet Brier.

found to be attached to the calyx. They are, therefore, *perigynous.*

49. To understand the construction of the pistil, you must make a vertical section through the roundish green mass which you will find on the under side of the flower.

Fig. 44.

You will then have presented to you some such appearance as that in Fig. 44. The green mass, you will observe, is hollow. Its outer covering is simply the continuation of the calyx-tube. *The lining of this calyx-tube is the receptacle of the flower;* to it are attached the separate carpels which together constitute the pistil (Fig. 45), just as the carpels of the Buttercup are attached to the *raised* receptacle of that flower.

We must remind you again that whenever the ovary is enclosed in the calyx-tube, and the calyx appears to spring from the summit of the ovary, the latter is said to be *inferior*, and the former *superior.*

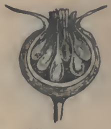


Fig. 45.

In the case of Sweet Brier and similar forms, where the pistil is strictly apocarpous, and the other parts cohere at their base so as to form a tube enclosing the really free carpels, the pistil may be described as *half-inferior*, and the calyx consequently as *half-superior.*

50. **Strawberry.** So far as calyx, corolla, and stamens are concerned, the flower of Strawberry very nearly resembles that of Sweet Brier. Alternating with the five calyx-lobes, however, will be found five bractlets,

Fig. 44.—Vertical section through the pistil.
Fig. 45.—Vertical section through ripe fruit of Sweet Brier.

which constitute, as in Mallow, an *epicalyx*. The pistil must be carefully examined. In this case there will be found a conical elevation in the centre of the flower, on the surface of which are inserted many separate carpels, much in the same way as in Buttercup. At maturity this elevated receptacle will have become greatly enlarged and pulpy, with the real fruit, the ripened carpels, dotted over its surface (Fig. 46).


Fig. 46.

51. **Cherry** or **Plum.** Here also the calyx, corolla, and stamens are all adherent, and a hollow cup is formed, in the bottom of which (but entirely free from these parts) the pistil is developed (Fig. 47). It consists of a single carpel, in which there are at first two ovules, though generally but one seed is ripened. The fruit is called a *drupe*, the seed being surrounded by three distinct layers: (1) a hard shell (the *putamen*), (2) a mass of soft pulp, and (3) the outer skin.


Fig. 47.

52. **Crab-Apple.** Here, as before, we have a gamosepalous calyx, the lower part forming a tube. The five petals are separate and inserted on the calyx, as are also the numerous stamens. To understand the structure of the pistil, make a vertical section through the centre of the flower, and also a cross section. The cross section

Fig. 46.—Vertical section of Strawberry.
Fig. 47.—Vertical section through flower of Cherry. (Gray.)

(Fig. 50) will show you that in this case we have a syncarpous pistil of five carpels, and the vertical section (Fig. 49) shows that the ovary is here truly *inferior*, the calyx-tube being completely adherent or *adnate* to it. The style is divided into five parts, corresponding to the five carpels.

Fig. 48.

Fig. 49.

53. At maturity, whilst the pistil or central organ has enlarged considerably, it will be found that the calyx-tube, which is adherent to it, has also grown very much. It is, in fact, the largely developed calyx-tube which constitutes the edible part of the apple, the true pistil forming the core. It is not very easy to distinguish the line which separates these two parts of the ripe fruit, but if a cross-section be made through the apple a circle of greenish dots may generally be made out at the outer limit of the core. A fruit of this sort is called a *pome*. The withered calyx-teeth may be found in the hollow at the end opposite the stem, as also, generally, the remains of the five styles.

Fig. 50.

Fig. 48.—Flower of Crab-Apple. Fig 49.—Vertical section of ovary.
Fig. 50.—Cross section of fruit of Crab-Apple.

Goose-Berry, apple, Pear,

54. **Raspberry.** Calyx, corolla, and stamens have the same arrangement as in Strawberry, and the pistil is likewise apocarpous, the numerous carpels covering the surface of a raised receptacle. But here the carpels do not produce *achenes.* Each of them at maturity forms a fruit resembling a drupe, so that the raspberry is a mass of drupes heaped upon a common receptacle.

55. Let us now sum up our observations upon the representatives of the great Order of Rosaceous plants. We have found them to possess the following characters in common:

1. *The petals and the numerous stamens are inserted on the calyx (perigynous).*
2. *The pistil, except in the Apple, is apocarpous and free from the calyx.*
3. *It may be added that the leaves are furnished with stipules.*

56. The differences (which lead to the sub-division of the Order into subordinate groups) are chiefly in the fruit. In Sweet Brier, with which may be compared any wild Rose, the achenes are enclosed in the calyx-tube. In Strawberry the receptacle is conical; so also in Raspberry. In the Cherry the carpel is single, forming a drupe. In the Apple the ovary is syncarpous and combined with the fleshy calyx. Compare with the Apple the Hawthorn and the Mountain Ash or Rowan Tree.

57. The following are the schedules descriptive of Sweet Brier and Crab-Apple. Those relating to Cherry, Strawberry, and Raspberry should be carefully filled up by the pupil.

SWEET BRIER.

Organ.	No.	Cohesion.	Adhesion.	Remarks.
Calyx. *Sepals.*	5	Gamosepalous	Half-superior.	
Corolla. *Petals.*	5	Polypetalous.	Perigynous.	
Stamens.	∞	Polyandrous.	Perigynous.	
Pistil. *Carpels.*	∞	Apocarpous.	Half-inferior.	The hollow receptacle lines the calyx-tube

CRAB-APPLE.

Organ.	No.	Cohesion.	Adhesion.	Remarks.
Calyx. *Sepals.*	5	Gamosepalous.	Superior.	
Corolla. *Petals.*	5	Polypetalous.	Perigynous.	
Stamens.	∞	Polyandrous.	Perigynous.	
Pistil. *Carpels.*	5	Syncarpous.	Inferior.	Fruit consists chiefly of a fleshy enlargement of the calyx-tube.

CHAPTER VII.

EXAMINATION OF A PLANT WITH EPIGYNOUS STAMENS—WATER-PARSNIP.

58. **Water-Parsnip.** This is a common swamp plant in Canada; but if any difficulty be experienced in procuring specimens, the flower of the common Carrot or Parsnip or of Parsley may be substituted for it, all these plants being closely related, and differing but slightly in the structure of their flowers.

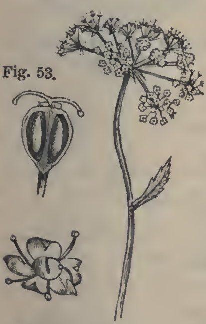


Fig. 53.

Fig. 52. Fig. 51.

Notice first the peculiar appearance of the flower cluster (Fig. 51). There are several pedicels, nearly of the same length, radiating from the end of the peduncle, and from the end of each pedicel radiate in like manner a number of smaller ones, each with a flower at its extremity. Such a cluster is known as an *umbel.* If, as in the present case, there are groups of secondary pedicels, the umbel is *compound.* As the flowers are very small we shall be obliged to use the lens all through the examination. Even with its aid you will have a little difficulty in making out the calyx, the tube of which, in this flower, adheres to the surface of the ovary, as in Willow-herb, and is reduced above to a mere rim or border of five minute teeth. The petals are five in number, and free from each other. Observe that each of them is *incurved* at its extremity

Fig. 51.—Compound umbel of Water-Parsnip.
Fig. 52.—Single flower of same. Fig. 53.—Vertical section of the ovary.

Hemlock - Parsley, Sweet Cicely

Fig. 52). They are inserted *on a disk which crowns the ovary*, as are also the five stamens, which are hence said to be *epigynous*. In the centre of the flower are two short styles projecting above the disk, and a vertical section through the ovary (Fig. 53) shows it to be two-celled, with a single seed suspended from the top of each cell.

WATER-PARSNIP.

ORGAN.	NO.	COHESION.	ADHESION.	REMARKS.
Calyx. *Sepals.*	5	Gamosepalous	Superior.	Calyx-teeth almost obsolete.
Corolla. *Petals.*	5	Polysepalous.	Epigynous.	Petals incurved.
Stamens.	5	Pentandrous.	Epigynous.	
Pistil. *Carpels.*	2	Syncarpous.	Inferior.	

59. The Water-Parsnip is a type of the large Order *Umbelliferæ*, which is well marked by the following characters:

1. *The flowers are clustered in umbels, and these are generally compound.*
2. *The calyx is perfectly adherent to the ovary, so that almost none of it projects above.*
3. *The petals and stamens (five each) are epigynous.*
4. *The ovary is two-celled, and is surmounted by two styles. At maturity the pistil separates into two dry carpels.*

CHAPTER VIII.

EXAMINATION OF COMMON PLANTS WITH EPIPETALOUS STAMENS—DANDELION—CATNIP.

60. **Dandelion.** The examination of this flower will be somewhat more difficult than that of any we have yet undertaken.


Fig. 54.

Provide yourselves with specimens in flower and in seed.

The root of the plant, like that of the Mallow, is a tap-root.

The stem is almost suppressed, and, as in the case of the Hepatica, the leaves are all radical. They are also net-veined.

The flowers are raised on scapes, which are hollow. At first sight the flower appears to have a calyx of many sepals, and a corolla of many petals. Both of these appearances, however, are contrary to facts. With a sharp knife cut the flower through the middle from top to bottom (Fig. 54). It will then appear that the flower, or rather *flower-head*, is made up of a large number of distinct pieces. With the point of your needle detach one of these pieces. At the lower end of it you have a small body resembling an unripe seed (Fig. 55). It is, in fact, an ovary. Just above this there is a short bit of stalk, surmounted by a circle of silky hairs, and above this a yellow tube with one side greatly prolonged. This yellow tube is a corolla, and a close examination of the extremity of


Fig. 55.

Fig. 54.—Vertical section of Dandelion flower.
Fig. 55—Single floret.

its long side will show the existence of five minute points, or teeth, from which we infer that the tube is made up of five coherent petals. As the corolla is on the ovary, it is said to be *Epigynous*.

Fig. 56.

Out of the corolla protrudes the long style, divided at its summit into two stigmas.

To discern the stamens will require the greatest nicety of observation. Fig. 56 will help you in your task. The stamens are five in number. They are inserted on the tube of the corolla (*epipetalous*) and their anthers cohere (Fig. 57), and form a ring about the style. When the anthers are united in this way, the stamens are said to be *syngenesious*.

61. It appears, then, that the Dandelion, instead of being a single flower, is in reality a compound of a great many flowers upon a common receptacle, and what seemed at first to be a calyx is, in reality, an *involucre*, made up of many bracts.

Fig. 57.

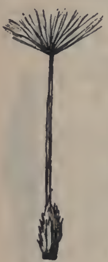


Fig. 58.

But have the single flowers, or *florets*, as they are properly called, no calyx? The theory is that they have one, but that it is adherent to the surface of the ovary, and that the tuft of silky hairs which we noticed is a prolongation of it.

Now turn to your specimen having the seeds ready to blow away. The seeds are all single; the little bit of stalk at the top has grown into a long slender thread, and the tuft of hairs has spread out like the rays of an umbrella (Fig. 58). But though the seeds are

Fig. 56.—Corolla laid open to show epipetalous stamens.

Fig. 57.—Syngenesious anthers of Dandelion. Fig. 58.—Fruit of Dandelion.

invariably single, it is inferred from the two-lobed stigma that there are *two carpels.* The following is the schedule:

DANDELION.

ORGAN.	No.	COHESION.	ADHESION.	REMARKS.
Calyx.		Gamosepalous	Superior.	The number of sepals is *inferred from analogy* to be five.
Sepals.	5			
Corolla.		Gamopetalous	Epigynous.	irregular
Petals.	5			
Stamens.	5	Syngenesious.	Epipetalous.	
Pistil.		Syncarpous.	Inferior.	Number of carpels inferred from number of stigmas.
Carpels.	2			

62. Flowers constructed on the plan of the Dandelion are called *Composite* flowers. The Order (Compositæ) comprises an immense number of common plants, in some of which all the corollas in the head are, as in the Dandelion, of one sort, namely, with one side prolonged into a strap, and hence called strap-shaped or *ligulate.* In most cases, however, the ligulate corollas form a circle round the margin of the head only, as in Sunflower, while the central *disk* is filled up with small regular gamopetalous corollas with a five-toothed border. Or it may happen, as in Thistle, that all the flowers are regular, ligulate corollas being absent. These, however, are minor points, and, while serving to distinguish subordinate groups, do not interfere with the great and salient characters which mark the Order as a whole. So, also,

Fireweed, Golden-rod, Aster, Fleabane,

Ox-eye Daisy May-weed Sun-flower

instead of the tuft of silky hairs (technically called the *pappus*) which surmounts the ovary, there may be, as in Sunflower, a few teeth-like projections, or scales, or a mere rim hardly to be distinguished at all.

63. The Order is easily recognized by the following characters:

1. *The flowers, or florets, are in heads on a common receptacle, and surrounded by an involucre.*
2. *The stamens are inserted on the corolla, and are united by their anthers (syngenesious).* epi-petalous
3. *The style is 2-lobed at the apex.*

64. Representatives of this Family are so numerous that it is needless to give a list. Specimens exhibiting all the variations in regard to the corollas, pappus, &c., should be gathered and notes made of their structure. In Part II. will be found a very full account of all the species likely to be met with, and the exercise book has a number of blank schedules specially arranged for Composites.

65. **Catnip.** Note carefully the appearance of the stem. It is *square.*

The flowers are in axillary clusters. The calyx is a tube (Fig. 59), terminating in five sharp teeth, and you may observe that the tube is a little longer on the upper side (that is, the side *towards* the stem) than on the lower. The corolla is somewhat peculiar. It has somewhat the appearance of a wide-open mouth, and is known as a *labiate* or two-lipped corolla. The upper lip is erect and notched at the apex.


Fig. 59.

Fig. 59.—Flower of Catnip.

The lower lip spreads outward, and consists of a large central lobe and two small lateral ones. Altogether, therefore, there are *five* lobes constituting the gamopetalous corolla. Pull out the corolla, and with the point of your needle split its tube in front. On laying it open, the stamens will be found to be inserted upon it (epipetalous). They are four in number, two of them longer than the other two. Hence they are described as *didynamous*. The anthers are peculiar in not having their lobes parallel (Fig. 60), these being wide apart at the base, in consequence of the expansion of the *connective*, the name given to that part of the anther which unites its two lobes or cells.

Fig. 60.

The pistil consists of a two-lobed stigma, a long-style, and an ovary which seems at first as if made up of four distinct carpels (Fig. 61). But the two-lobed stigma will warn you against this supposition. The ovary really consists of *two* carpels, each of two deep lobes, and, as the seeds ripen, these lobes form four little nutlets (Fig. 62), each containing a single seed.

Fig. 62.

Fig. 61.

66. The Catnip is a type of the Order *Labiatæ* (Mint Family), so called because the corollas are usually labiate. It is marked by the following characters:

1. *The stem is square, and the leaves are opposite and generally aromatic.*
2. *The corolla is more or less labiate.*
3. *The stamens are mostly didynamous.*

Fig. 60.—Front view of the same. Fig. 61.—Pistil of Catnip.
Fig. 62.—Ripe ovary of four separate nutlets.

4. The ovary is four-lobed, and at maturity breaks up into four nutlets.

Other types are the various Mints, Sage, Thyme, Summer Savory, Pennyroyal, Bergamot, Self-heal, Horehound, &c., many of which are of very common occurrence.

CATNIP.

ORGAN.	No.	COHESION.	ADHESION.	REMARKS.
Calyx. *Sepals.*	5	Gamosepalous	Inferior.	Calyx-tube nerved.
Corolla. *Petals.*	5	Gamopetalous	Hypogynous.	Two-lipped. Upper lip of two, and lower of three, lobes.
Stamens. *Anthers.*	4	Didynamous.	Epipetalous.	Lobes of anthers not parallel.
Pistil. *Carpels.*	2	Syncarpous.	Superior.	The ripe ovary of four nutlets.

CHAPTER IX.

EXAMINATION OF PLANTS WITH MONŒCIOUS FLOWERS—CUCUMBER—OAK.

67. **Cucumber.** You can hardly have failed to notice that only a small proportion of the blossoms on a Cucumber vine produce cucumbers. A great many

wither away and are apparently of no use. An attentive inspection will show that some of the blossoms have oblong fleshy protuberances beneath them, whilst others are destitute of these attachments. Select a flower of each kind, and examine first the one with the protuberance (Fig. 63), which latter, from its appearance, you will probably have rightly guessed to be the ovary. The situation of the ovary here, indeed, is the same as in the Willow-herb. The calyx-tube adheres to its surface, and is prolonged to some little distance above it, expanding finally into five teeth. The corolla is gamopetalous, and is adherent to the calyx. Remove now the calyx and the adherent corolla, and there is left in the centre of the flower a short column, terminating in three stigmas, each two-lobed.

Fig. 63.

There are no stamens.

68. Now examine the other blossom (Fig. 64). Calyx and corolla have almost exactly the same appearance as before. Remove them, and you have left three stamens growing on the calyx-tube, and slightly united by their anthers (syngenesious). *There is no pistil.*

Fig. 64.

Fig. 63.—Pistillate flower of Cucumber.
Fig. 64.—Staminate flower of Cucumber.

You see now why some blossoms produce cucumbers and others do not. Most of the blossoms have no pistil, and are termed *staminate* or *sterile* flowers, whilst the others are *pistillate* or *fertile.* Flowers in which either stamens or pistils are wanting are also called *imperfect.* When staminate and pistillate flowers grow on the same plant, as they do in the case of the Cucumber, they are said to be *monœcious.*

69. In plants of this kind the pollen of one kind of blossom is conveyed to the stigmas of the other kind, chiefly by insects, which visit the flowers indiscriminately in search of honey. The pollen dust clings to their hairy legs and bodies, and is presently rubbed off upon the stigma of some fertile flower.

70. In order to describe monœcious flowers, our schedule will require a slight modification. As given below, the symbol ♂ stands for "staminate flower," and the symbol ♀ for "pistillate flower."

CUCUMBER.

ORGAN.	NO.	COHESION.	ADHESION.	REMARKS.
Calyx. *Sepals.*	5	Gamosepalous	Superior.	
Corolla. *Petals.*	5	Gamopetalous	Perigynous.	
♂ Stamens.	3	Syngenesious.	Perigynous.	Two anthers are 2-celled and one 1-celled.
♂ Pistil. *Carpels.*	0			
♀ Stamens.	0			
♀ Pistil. *Carpels.*	3	Syncarpous.	Inferior.	

71. Oak. The Oaks are among our finest and most valuable forest-trees, and while everyone is familiar with

Fig. 66.

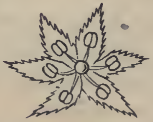


Fig. 67.

Fig. 65.

the appearance of the *acorn*, as the fruit of the Oak is

Fig. 66.—Twig of White Oak with sterile catkins.
Fig. 67.—Single staminate flower.
Fig. 68.—Fruit and leaf of Oak. (Wood and Steele.)

called, the fact that the flowers are not to be obtained without effort on account of their distance from the ground, as well as the circumstance of their being rather inconspicuous, may lead to their being overlooked unless special attention is directed to them. The White Oak is perhaps the best known species with us. It may be pretty well distinguished from other species by its leaves, the lobes of which (Fig. 65) are *rounded.* However, for the purposes of this lesson, any other species may be used, if the White Oak is not at hand. The flowers are monœcious, the sterile ones forming long and slender drooping catkins, which are either single or, more generally, several in a cluster, from the same lateral bud (Fig. 66). Each sterile flower (Fig. 67) consists of a perianth or calyx of a variable number of sepals, mostly from four to six, and generally eight stamens. The fertile flowers spring mostly from the axils of the leaves of new shoots, and they occur either singly or two or three in a cluster. Each flower consists of a syncarpous pistil of three carpels. The ovary is three-celled, or nearly so, and two ovules are formed in each cell. The flower is surrounded at the base by a scaly involucre, which, at maturity, has become quite woody, and forms in fact the *cup* in which the acorn rests. If you dissect an acorn you will observe that *there is but one seed in it.* Although the ovary contains six ovules at starting, it always happens that all but one disappear before the fruit is matured.

The White Oak ripens its acorns the first year. The Red Oak, on the other hand, does not ripen its fruit till the autumn of the second year.

72. It will be a valuable exercise to compare flowers of the Beech with those just described. They will be found

to be monœcious also; the sterile ones in small drooping heads, with stamens and sepals variable in number, and the fertile ones from the axils of new leaves, usually two together, surrounded by an involucre of many bristle-pointed scales. These develope into the familiar bristly four-valved involucre which encloses the pair of three-cornered nuts at maturity. Each nut is the product of one flower, and contains but one seed, although at first the ovary was (like that of the Oak) three-celled, with two ovules in each cell.

These resemblances lead us to the conclusion that the Oak and the Beech are nearly related plants. They belong to the same Order (*Cupuliferæ*), as do also the Ironwood, the Chestnut, and the Hazelnut, all of which should be examined and compared, if within reach.

73. The following are the distinguishing characters of the Order:

1. *The flowers are monœcious, the sterile ones being in catkins (or, in Beech, in close heads), the fertile single or in small clusters, with an involucre forming at maturity a cup or covering for the 1-seeded nut.*
2. *The ovary is at first several-celled, but at maturity is 1-celled and 1-seeded.*

The pupil will write out descriptions of one or more representatives of the Order, taking the description of Cucumber for his model.

CHAPTER X.

EXAMINATION OF PLANTS WITH DIŒCIOUS FLOWERS—WILLOW—MAPLE.

74. **Willow.** The flowers of most kinds of Willow appear in spring or early summer before the leaves. They grow from the axils in long, close clusters called *catkins* or *aments.* Collect a few of these *from the same tree or shrub.* You will find them to be exactly alike. If the first one you examine is covered with yellow stamens (Fig. 68), all the rest will likewise consist of stamens, and you will search in vain for any appearance of a pistil. If, on the other hand, one of your catkins is evidently destitute of stamens, and consists of oblong pistils (Fig. 69), then all the others will in like manner be found to be without stamens. Unlike our Cucumber plant, the staminate and pistillate flowers of the Willow are borne on *different* plants. These flowers are therefore said to be *diœcious.* As a general thing, staminate and pistillate catkins will be found upon trees not far apart. Procure one of each kind, and examine first the staminate one. You will probably find the stamens in pairs. Follow any pair of filaments down to

Fig. 68.

Fig. 69.

Fig. 70.

Fig. 68.—Staminate catkin of Willow. Fig. 69.—Fertile catkin.
Fig. 70.—Single staminate flower.

their insertion, and observe that they spring from the axil of a minute bract (Fig. 70). These bracts are the *scales* of the catkin. There is no appearance of either calyx or corolla, and the flowers are therefore said to be

Fig. 71.

achlamydeous, that is, without a covering. Now look at the fertile catkin. Each pistil will, like the stamens, be found to spring from the axil of a scale (Fig. 71). The stigma is two-lobed, and, on carefully opening the ovary, you observe that though there is but one cell yet there are *two rows of seeds.* We therefore infer that the pistil consists of two carpels. The pistillate flowers, like the staminate, are achlamydeous. In diœcious plants

HEART-LEAVED WILLOW.

ORGAN.	No.	COHESION.	ADHESION.	REMARKS.
Calyx.	0			
Corolla.	0			
♂ Stamens.	2	Diandrous.	0	
♂ Pistil.	0			
♀ Stamens.	0			
♀ Pistil.		Syncarpous.	0	
Carpels.	2			

the process of fertilization is assisted by insects, especially when the flowers are showy or odoriferous and nectar-

Fig. 71.—Single pistillate flower of Willow.

bearing; otherwise the wind is the principal agent. Flowers which depend on insects to effect the transfer of pollen from the anther to the stigma are said to be *entomophilous.* Those which depend upon the wind are *anemophilous.* The Willow belongs to the former class.

75. **Maple.** In early spring, while the branches are as yet bare of leaves, our Red Maples are covered with a profusion of scarlet and yellow blossoms, and the air about them is alive with busy insects gathering honey for themselves, and performing at the same time an important service for the trees in return; for it will be found on examining a few of the trees that, like the Willow, they do not all bear the same kind of flowers. In some, the ends of the reddish twigs will present the appearance shown in Fig. 72, with numerous stamens protruding from the scaly lateral buds. On looking into one of these buds it will be found that there are several flowers on short pedicels, each like that shown in Fig. 73, except that the number of stamens will probably be found to be somewhat variable. Observe the fleshy disk in the bottom of the calyx, upon which the stamens are inserted. These flowers with the projecting stamens are without pistils. They produce nothing but pollen, and the tree upon which you find them produces no [illegible]d.

Fig. 72.

Fig. 73.

Fig. 72.—Twig of Red Maple bearing staminate flowers.
Fig. 73.—Single staminate flower. (Wood & Steele).

In other trees, the twigs will be found to resemble Fig. 74. The scaly buds are present, and the clusters of flowers within them as before, but the projecting stamens are wanting. If stamens are present at all, they are short and almost concealed in the calyx, as shown in Fig. 75, where two anthers are just visible over the edge of the calyx. The centre of the flower is occupied by a syncarpous pistil, having a two-celled ovary and two long styles, as shown in the figure.

Fig. 74.

Fig. 75.

The flowers of the Maple, therefore, being sterile or staminate upon one tree, and fertile or pistillate upon another, are, as in Willow, said to be diœcious; or, if we take into account the fact that some of the flowers have stamens as well as pistils, we shall more accurately describe the whole inflorescence (or mode of flowering) as *polygamo-diœcious*.

In Maple, as in Willow, the assistance of insects is necessary to ensure the transfer of the pollen to the stigma. The flowers are, therefore, entomophilous.

Fig. 76.

After fertilization, a *wing* is developed from the back of each of the two carpels, and the pedicels lengthen, so that as the fruit ripens it presents the familiar aspect of hanging clusters of double *samaras*, as these winged fruits are called (Fig. 76).

Fig. 74.—Twig of Red Maple bearing pistillate flowers.
Fig. 75.—Single pistillate flower. (Wood & Steele.)
Fig. 76.—Winged fruit or samara of Maple.

The Red Maple ripens its seeds early in the summer, and these, on falling, germinate immediately, so that by the autumn of the same year a vigorous young tree, a foot or more in height, is produced. The seeds will not germinate if kept over till the following spring.

The Sugar Maple, on the other hand, flowers later, the leaves and flowers appearing about the same time, and the seeds do not ripen till the fall. If kept slightly moist through the winter they will germinate the following spring.

76. The several species of common occurrence should be carefully studied and distinguished. Their characteristics are given in the proper place in Part II.

The Maples form a subordinate group of the natural Order *Sapindaceæ.* They are distinguished by the following characters :

1. The flowers are diœcious (or polygamo-diœcious), and commonly unsymmetrical.

2. The ovary is two-lobed and two-celled, with two ovules in each cell, only one of which, however, is ripened.

3. The fruit is a double samara.

4. The leaves are opposite.

77. From this type there are important deviations in other representatives of the Order. Horse-chestnut, for instance, while its flowers are unsymmetrical and somewhat irregular, as in the Maples, produces a *three-celled* ovary, with two ovules in each cell. But as in Maple, again, only one ovule in each cell forms a seed. The fruit, however, is not a samara, but a leathery pod which splits into three pieces at maturity, liberating the three large shining seeds.

Schedules descriptive of the Maple should be filled up, taking that of Willow as the model.

CHAPTER XI.

CHARACTERISTICS POSSESSED IN COMMON BY ALL THE PLANTS PREVIOUSLY EXAMINED—STRUCTURE OF THE SEED IN DICOTYLEDONS.

78. Before proceeding further in our examination of plants, we shall direct your attention to some characters of those already examined, which they all possess in common. The leaves of every one of them are *net-veined.* Some leaves, at least, of each of them have distinct petioles and blades. The parts of the flowers we found, as a general thing, to be in *fives.* In one or two instances they were in *fours*, that is four sepals, four petals, and so on.

Fig. 77. Fig. 78. Fig. 79.

79. Now, in addition to these resemblances, there are others which do not so immediately strike the eye, but which, nevertheless, are just as constant. One of these is to be found in the structure of the embryo. Take a Cucumber or a Pumpkin seed, and having soaked it for some time in water, remove the outer coat. The body of the seed will then readily split in two, except where the parts are joined at one end (Figs. 77, 78, 79). The thick lobes are called *cotyledons*, or *seed-leaves*, and as there are two, the embryo is *dicotyledonous.* The pointed end where the cotyledons

Figs. 77, 78, 79.—Different views of Pumpkin seed, showing radicle, cotyledons, and plumule.

are attached, and from which the root is developed, is called the *radicle*, a term meaning "little root." As it is strictly, however, a rudimentary *stem*, and not a root, the term *caulicle* would be better. Between the cotyledons, at the summit of the radicle, you will find a minute upward projection. This is a bud, which is known as the *plumule*. It developes into the stem.

80. If you treat a Pea or a Bean (Figs. 80, 81) in the same manner as the Cucumber seed, you will find it to be constructed on the same plan. The embryo of the Bean is dicotyledonous also. But you will observe that in these cases the embryo occupies the whole of the interior of the seed. In describing the seed of the Buttercup, it was pointed out that the embryo occupies but a very small space in the seed, the bulk of the latter consisting of *albumen*. Seeds like those of the Buttercup are therefore called *albuminous* seeds, while those of the Bean and Pea are *exalbuminous*. But, notwithstanding this difference in the structure of the seed, the *embryo* of the Buttercup, when examined under a strong magnifier, is found to be dicotyledonous like the others. In short, the dicotyledonous embryo is a character common to all the plants we have examined—common, as a rule, to all plants possessing the other characters enumerated above. From the general constancy of all these characters, plants possessing them are grouped together in a vast Class, called Dicotyledonous plants, or, shortly, **Dicotyledons.**

Fig. 80.

Fig. 81.

Figs. 80 and 81.—Seed of the Bean.

81. Besides the characters just mentioned, there is still another one of great importance which Dicotyledons possess in common. It is *the manner of growth of the stem.* In the Willow, and all our trees and shrubs without exception, there is an outer layer of bark on the stem, and the stem increases in thickness, year by year, by forming a new layer just inside the bark and *outside the old wood.* These stems are therefore called *exogenous*, that is, *outside growers.*

Now, in all Dicotyledonous plants, whether herbs, shrubs, or trees, the stem thickens in this manner, so that **Dicotyledons** are also **Exogens**.

CHAPTER XII.

EXAMINATION OF COMMON PLANTS CONTINUED—DOG'S-TOOTH VIOLET—TRILLIUM—IRIS—ORCHIS.

82. **Dog's-tooth Violet.** This plant (Fig. 82), which flowers in spring, may be pretty easily recognized by its peculiar blotched leaves. It may be found in rich, moist pasture lands and low copses. The name "Violet" is somewhat unfortunate, because the plant is not in any way related to the true Violets. To obtain a complete specimen requires some trouble, owing to the fact that the root is commonly six inches or so below the surface of the ground ; you must therefore insert a spade or strong trowel sufficiently deep to avoid cutting or breaking the tender stem. Having cleared away the adhering earth, you will find that the roots proceed from what appears to be the

swollen end of the stem. This swollen mass is coated on the outside with thin scales. A section across the middle shows it to be more or less solid, with the stem growing

Fig. 82.

up through it from its base. It is, in fact, not easy to say how much of this stem-like growth is in reality stem,

Fig. 82.—Dog's-tooth Violet.

because it merges gradually into the scape, which bears the flower, and the petioles of the leaves, which sheathe the scape. The swollen mass is called a *bulb.*

83. The leaves are two in number, gradually narrowing at the base into sheaths. If you hold one of them up to the light, you will observe that the veins do not, as in the leaves of the Dicotyledonous plants, form a network, but run only in one direction: namely, from end to end of the leaves. Such leaves are consequently called *straight-veined.*

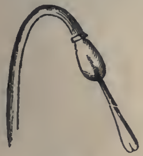


Fig. 83.

84. In the flower there is no appearance of a green calyx. There are six yellow leaves, nearly alike, arranged in two sets, an outer and an inner, of three each. In such cases, we shall speak of the coloured leaves collectively as the *perianth.* If the leaves are free from each other we shall speak of the perianth as *polyphyllous,* but if they cohere we shall describe it as *gamophyllous.* Stripping off the leaves of the perianth, we find six stamens with long upright anthers which open along their outer edges. If the anthers be pulled off, the filaments will be found to terminate in long, sharp points.

The pistil (Fig. 83) has its three parts—ovary, style, and stigma—well marked. The stigma is evidently formed by the union of three into one. The ovary, when cut across, is seen to be three-celled (Fig. 84), and is, therefore, syncarpous.

Fig. 84.

Fig. 83.—Pistil of Dog's-tooth Violet.
Fig. 84.—Cross section of the pistil.

DOG'S-TOOTH VIOLET.

Organ.	No.	Cohesion.	Adhesion.	Remarks
Perianth.		Polyphyllous.	Inferior.	
Leaves.	6			
Stamens.	6	Hexandrous.	Hypogynous.	Filaments terminating in sharp points.
Pistil.		Syncarpous.	Superior.	
Carpels.	3			

Fig. 85.

Fig. 87.

Fig. 86.

85. **Trillium.** This plant (Fig. 85) may be found in flower about the same time as the one just described. The perianth of Trillium consists of six pieces in two sets, but in this case the three outer leaves are green, like a common calyx. The stamens are six in number. There are three styles, curving outwards, the whole of the inner side of each being stigmatic. The ovary (Fig. 86) is six-angled, and on being cut across is seen to be three-celled.

Fig. 85.—Trillium. Fig. 86.—Cross section of the pistil. Fig. 87.—Net-veined leaf of Trillium.

86. Comparing this flower with that of Dog's-tooth Violet, we find the two to exhibit a striking resemblance in structure. But in one respect the plants are strikingly unlike: *the leaves of the Trillium are net-veined* (Fig. 87), as in the Exogens. From this circumstance we learn that we cannot altogether rely on the veining of the leaves as a *constant* characteristic of plants whose parts are not in fives.

TRILLIUM.

Organ.	No.	Cohesion.	Adhesion.	Remarks.
Perianth.		Polyphyllous.	Inferior.	Sepals persistent.
Sepals.	3			
Petals.	3			
Stamens.	6	Hexandrous.	Hypogynous.	
Pistil.		Syncarpous.	Superior.	The inner face of each style stigmatic.
Carpels.	3			
Leaves net-veined.				

87. The two plants just examined are types of the natural Order *Liliaceæ*. The distinguishing characters are as follows:

1. *The parts of the flower are almost invariably in sets of three, the perianth being of two such sets, and also the stamens. The flowers are therefore symmetrical; they are also regular.*
2. *The stamens are opposite the divisions of the perianth.*
3. *The ovary is nearly always 3-celled, and is superior.*

The representatives of this large Order are very numerous. From the gardens may be had lilies of various sorts, Asparagus, Star-of-Bethlehem, Tulip, Onion, Hyacinth, &c., whilst the fields and woods supply the Bellwort, Clintonia, Solomon's Seal, Smilacina, and others. As a rule the plants flower in spring and early summer.

88. **Iris.** For this lesson any variety of the common garden Flag will answer very well. In our marshes in early summer abundant specimens of a wild species may be obtained without much trouble, but the cultivated plants will probably be more accessible. Note first the fleshy underground stem or root-stock, with the fibrous roots below (Fig. 88). If you have a sufficient length of this root-stock you will notice the scars upon the older portions, showing where the leaves of former seasons have been sent up. The new buds expand into a crowded cluster of leaves, the shape and arrangement of which should be carefully observed. Cut the whole cluster across near the base, and the section will be as represented in Fig. 89, the section of each leaf being V-shaped,

Fig. 89.

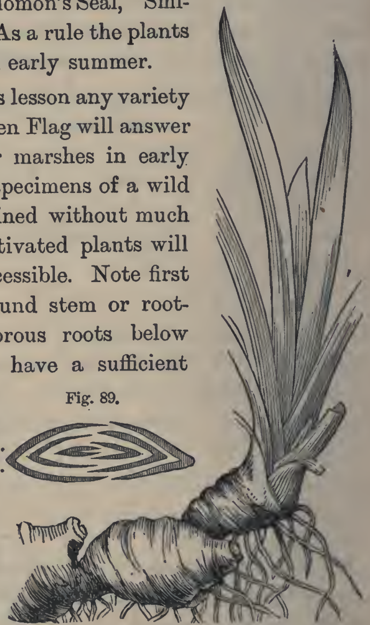


Fig. 88.

Fig. 88.—Root-stock and leaves of Iris. (Gray.)

Fig. 89.—Cross section of cluster of equitant leaves. (Gray.)

and *astride* the next one within. Leaves disposed in this manner are consequently said to be *equitant* (*eques*, a horseman). As the leaf rises upward it alters in shape, becoming flat and sword-like. Besides being equitant, these leaves, on account of their direction, are described as *vertical*. You will observe, also, that they are straight-veined.

From the centre of the cluster of leaves rises the scape which bears the flower. If your specimen has a flower-bud upon it, as is most likely, you will notice the way in which its leaves are folded. The mode of folding here exhibited is common to a great many flowers, and is described as *convolute*. In the full-blown flower the perianth will be found to consist of six pieces, in two distinct sets of three each; the outer three are considerably larger than the others, and are bent backwards or *reflexed;* the inner ones are erect. There are three stamens, each of them beneath and close against an over-arching body, the nature of which is not at first quite manifest. Cut away the perianth and the stamens, and you will then have left the three radiating coloured arches (Fig. 90), which will be seen to unite below into a slender column. You have also left what is apparently the swollen top of the scape. This, when cut across, is found to be a three-celled ovary, which is thus, of course, *inferior*. The slender column above is the style, and the

Fig. 90.

Fig. 90.—Pistil of Iris. (Wood and Steele.)

three petal-like arches are its branches. Immediately beneath the tip of each arch will be found a thin lip or plate, which is the stigma.

The anthers open *outwards* to discharge the pollen, and this fact, in addition to the peculiar situation of the anther as regards the stigma, makes it almost impossible that self-fertilization should take place in this flower. As was the case with other flowers already examined, the Iris is honey-bearing, and, besides, exceedingly showy. The nectar is situated in a cavity at the bottom of the flower, and cross-fertilization is accomplished by the aid of insects. It will be remembered that flowers thus fertilized are said to be entomophilous.

89. The Crocus and Gladiolus of the gardens and the Blue-eyed Grass of our low meadows may be examined and compared with the Iris. They are all types of the natural Order *Iridaceæ*, which you will observe differs from *Liliaceæ* chiefly in having flowers with only three stamens and an inferior ovary.

IRIS.

Organ.	No.	Cohesion.	Adhesion.	Remarks.
Perianth. *Leaves.*	6	Gamophyllous	Superior.	2 sets. Outer, large and reflexed ; inner, erect.
Stamens.	3	Triandrous.	Perigynous.	Opposite the stigmas.
Pistil. *Carpels.*	3	Syncarpous.	Inferior.	Stigmas petal-like, arching over the extrorse anthers.

90. **Showy Orchis.** The flower of this plant (Figs. 91, 92) is provided with floral envelopes, all coloured like a corolla. As in Dog's-tooth Violet, we shall call them collectively the perianth, although they are not all alike. One of them projects forward in front of the flower,

Fig. 91.

forming the *lip*, and bears underneath it a long, hollow *spur* which, like the spurs of Columbine, is honey-bearing. The remaining five converge together, forming a kind of

Fig. 91.—Showy Orchis.

arch over the centre of the flower. Each flower springs from the axil of a leaf-like bract, and is apparently raised on a pedicel. What seems to be a pedicel, however, will, if cut across, prove to be the ovary, which in this case is inferior. Its situation is similar to the situation of the ovary in Willow-herb, and, as in that flower, so in this the calyx-tube adheres to the whole surface of the ovary, and the three outer divisions of the perianth are simply upward extensions of this tube. Notice the peculiar *twist* in the ovary. The effect of this twist is to turn the lip away from the scape, and so give it the appearance of being the lower petal instead of the *upper* one, as it really is.

Fig. 92.

91. The structure of the stamens and pistil remains to be examined, and a glance at the flower shows you that we have here something totally different from the common arrangement of these organs. In the axis of the flower, immediately behind the opening into the spur, there is an upward projection known as the *column*. The face of this column is the stigma; on each side of the stigma, and adhering to it, is an anther-cell. These cells, though separated by the column, constitute but a *single stamen*. The stamen, then, in this case is *united with the pistil*, a condition which is described as *gynandrous*.

Fig. 93.

92. If you have a flower in which the anther-cells are bursting open, you will see that the pollen does not issue from them in its usual dust-like form, but if you use the

Fig. 92.—Single flower of Orchis.

Fig. 93.—Pollen-mass of Orchis, greatly enlarged.

point of your needle carefully you may remove the contents of each cell *in a mass.* These pollen-masses are of the form shown in Fig. 93. The grains are kept together by a fine tissue or web, and the slender stalk, upon which each pollen-mass is raised, is attached by its lower end to a sticky disk on the front of the stigma just above the mouth of the spur. Insects, in their efforts to reach the honey, bring their heads in contact with these disks, and, when they fly away, carry the pollen-masses with them and deposit them on the stigma of the next flower visited. In fact, it is difficult to see how, without the aid of insects, flowers of this sort could be fertilized at all.

SHOWY ORCHIS.

Organ.	No.	Cohesion.	Adhesion.	Remarks.
Perianth.		Gamophyllous	Superior.	
Leaves.	6			
Stamens.	1	Monandrous.	Gynandrous.	Pollen-grains collected in masses.
Pistil.		Syncarpous.	Inferior.	
Carpels.	3			Ovary twisted.

93. Showy Orchis is a representative of the vast Order *Orchidaceæ*, the members of which are chiefly tropical. Some of our handsomest Canadian wild flowers, however, belong to it, such as the Lady's Slipper, the Rattlesnake Plantain, the beautiful little Calypso, and the Habenarias. Most of our orchids will be found in low and wet situations, and they flower rather early

in the year. The most remarkable characteristics of the Order are the gynandrous arrangement of the stamen or stamens, and the cohesion of the pollen-grains, though this latter peculiarity is exhibited also by other groups —notably, the Milkweeds.

CHAPTER XIII.

EXAMINATION OF SPADICEOUS PLANTS—INDIAN TURNIP—CALLA.

94. **Indian Turnip.** This plant may be easily met with in our woods in early summer. If you are not familiar with its appearance, the annexed cut (Fig. 94) will help you to recognize it. Procure several specimens: these will probably at first seem to you to be alike in every respect, but out of a number some are pretty sure to differ from the rest. Notice the bulb from which the stem springs. It differs from that of the Dog's-tooth Violet, and Lilies generally, in having a much larger solid part. It is called a *corm.* Between the pair of leaves you observe a curious striped sheath, having an arching, hood-like top, and enclosing an upright stalk, the top of which almost touches the hood (Fig. 95). Can this be a flower? It is certainly the only thing about the plant which at all resembles a flower, and yet how different it is from any we have hitherto examined! Carefully cut away the sheaths

from all your specimens. Most, and perhaps all, of them will then present an appearance like that in Fig. 96. If none of them be like Fig. 97 it will be well to gather a few more plants. We shall suppose, however,

Fig. 94.

that you have been fortunate in obtaining both kinds, and will proceed with our examination. Take first a specimen corresponding with Fig. 96. Around the base of the column are compactly arranged many spherical green bodies, each tipped with a little point. Separate

Fig. 94.—Indian Turnip.

one of these from the rest and cut it across. It will be found to contain several ovules, and is, in fact, an ovary, the point at the top being a stigma. In the autumn a great change will have taken place in the appearance of plants like the one we are now examining. The arched hood will have disappeared, as also the long naked top of the column, whilst the part below, upon which we are now engaged, will have vastly increased in size, and become a compact ball of red berries. There can be no doubt, then, that we have here a structure analogous to that found in the Cucumber and the Willow, the fertile, or pistillate, flowers being clustered together separately. But in the Cucumber all the flowers were observed to be furnished with calyx and corolla, and in the Willow catkins, though floral envelopes were absent, each pair of stamens and each pistil was subtended by a bract. In the present plant there are no floral envelopes, nor does each pistil arise from a separate bract.

Fig. 95.

Fig. 96. Fig. 97.

95. But, you will now ask, what is this sheathing hood which we find wrapped about our column of pistils?

Fig. 95.—Spathe of Indian Turnip.
Fig. 96.—Fertile spadix of the same. Fig. 97.—Sterile spadix.

There is no doubt that we must look upon it as a *bract*, because from its base the flower-cluster springs. So that, whilst the flowers of Indian Turnip are, like those of Willow, imperfect and diœcious, the clusters differ in having but a single bract instead of a bract under each flower.

96. We must now examine one of the other specimens; and we shall have no difficulty in determining the nature of the bodies which, in this case, cover the base of the column. They are evidently stamens, and your magnifying-glass will show you that they consist mostly of anthers, the filaments being extremely short, and that some of the anthers are two-celled and some four-celled, all discharging their pollen through little holes at the top of the cells.

INDIAN TURNIP.

ORGAN.	NO.	COHESION.	ADHESION.
♂ Stamens.	1	Monandrous.	0
♀ Pistil.		Apocarpous.	0
Carpels.	1		

Flowers crowded on a spadix, and surrounded by a spathe.
Leaves net-veined.

97. The column upon which, in plants like Indian Turnip, the flowers are crowded, is known as a *spadix*, and the surrounding bract as a *spathe*.

You will observe that the leaves of this plant are *net-veined*, as we found them in the Trillium.

98. **Marsh Calla.** This plant must be looked for in low, marshy grounds, where it will be found in flower generally in the month of June. With the knowledge which you have of the structure of Indian Turnip, you

Fig. 98.

Fig. 99.

will hardly doubt that the Calla is closely related to it. You will easily recognize the spadix and the spathe (Fig. 98), though in the present instance the spadix bears flowers to the top, and the spathe is open instead of enclosing the column. Observe, however, that the veining of the leaf (Fig. 99) is different, that of Calla being straight, like the Dog's-Tooth Violet. There is also a difference in the flowers. Those of Indian Turnip were found to be diœcious, but the spadix, in the present

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Fig. 98.—Spadix and spathe of Marsh Calla.
Fig. 99.—Leaf of the same.

case, bears both stamens and pistils, and most of the lower flowers, if not all, are *perfect;* sometimes the upper ones consist of stamens only. Fig. 100 shows one of the perfect flowers much enlarged. The stamens, it will be observed, have two-celled anthers, opening lengthwise.

Fig. 100.

MARSH CALLA.

Organ.	No.	Cohesion.	Adhesion.
Perianth.		Wanting.	
Stamens.	6	Hexandrous.	Hypogynous.
Pistil.		Apocarpous.	Superior.
Carpels.	1		

99. These two plants, Indian Turnip and Marsh Calla, are representatives of the Order *Araceæ.* The characters which distinguish it are very well displayed in the two types we have selected for examination. The great feature is the aggregation of the flowers on a spadix. Generally, though not invariably, a spathe is also present. Among wild plants the Skunk Cabbage and Sweet Flag (the latter without a spathe) are common Araceous types, while the familiar green-house and window plant, known as the Calla-Lily, will serve very well for examination in winter. It may be added that the plants of this Order have a very acrid juice.

Fig. 100.—Perfect flower of Calla.

CHAPTER XIV.

EXAMINATION OF GLUMACEOUS PLANTS—TIMOTHY AND OTHER GRASSES.

100. **Timothy.** The top of a stalk of this well-known grass is cylindrical in shape, and upon examination will be found to consist of a vast number of similar pieces compactly arranged on very short pedicels about the stalk as an axis. Carefully separate one of these pieces from the rest, and if the grass has not yet come into flower the piece will present the appearance shown in Fig. 101. In this Fig. the three points in the middle are the protruding ends of stamens. The piece which you have separated is, in fact, a flower enclosed in a pair of bracts, and all the other pieces which go to make up the top are flowers also, and, except perhaps a few at the very summit of the spike, precisely similar to this one in their structure.


Fig. 101.


Fig. 102.

101. Fig. 102 is designed to help you in dissecting a flower which has attained a greater degree of development than the one shown in Fig. 101. Here the two bracts which enclose the flower have been drawn asunder. To these bracts the name *glumes* is applied. They are present in all plants of the Grass Family, and are often

Fig. 101.—Closed flower of Timothy.
Fig. 102.—Expanded flower of the same.

found enclosing several flowers instead of one as in Timothy. Inside the glumes will be found a second pair of minute chaff-like bracts, which are known as *palets* or *pales.* These enclose the flower proper.

102. The stamens are three in number, with the anthers fixed by the middle to the long slender filament. The anthers are therefore *versatile.* The styles are two in number, bearing long, feathery stigmas. The ovary contains a single ovule, and when ripe forms a seed-like *grain,* technically known as a *caryopsis.*

TIMOTHY.

Organ.	No.	Cohesion.	Adhesion.
Glumes.	2		
Palets.	2		
Stamens.	3	Triandrous.	Hypogynous.
Pistil.		Apocarpous.	Superior.
Carpels.	1		

103. It will be observed that the stalk of Timothy is hollow except at certain swollen knot-like joints. This peculiar stem of the Grasses is called a *culm.* Occasionally, however, it is not hollow. The leaves are long and narrow and straight-veined, and each of them at its base surrounds the culm with a *split sheath.* Observe also that at the

junction of the blade and the sheath there is a thin appendage which is called a *ligule.*

104. In many grass-flowers, besides the parts described above there will be found one or two minute scales below the pistil. These are known as *lodicules*, and are analogous to the perianth in ordinary flowers. They are, on account of their minuteness, very liable to be overlooked in a superficial examination.

Fig. 104. Fig. 103.

105. The immense Order *Gramineæ* (Grass Family) includes all our valuable grains, and is, on the whole, the most important and useful of all the Orders. Its representatives are to be found in every part of the world, and they vary in size from the stunted growths of the polar regions to the tree-like Bamboo of the tropics. Wheat, Indian Corn, Barley, Oats, Rye, Sugar-cane, Rice, are all Grasses, as well as the plants which make the verdure of our meadows and pastures. The flowers of all are very similar, but the Order is sub-divided on the basis of

Fig. 103.—Panicle of Red-top.

Fig. 104.—Single flower. (Gray.)

modifications which will be best understood by studying a few examples.

106. Procure specimens of the common Red-top, and first compare the general aspect of the flower-cluster (Fig. 103) with that of Timothy. Instead of a dense spike we have here a loose, open inflorescence; it is technically known as a *panicle*. You will see that it is an irregular branched raceme. As in Timothy, *each pair of glumes encloses but one flower* (Fig. 104), and we must observe that the term *spikelet*, so far as Grasses are concerned, is applied to the pair of glumes and whatever is contained in them, whether one flower, or many, as is often the case. In Red-top and Timothy, *the spikelets are 1-flowered.* Observe the very thin texture of the *palets*, and also that one of them (the lower, *i.e.*, the one farthest from the stalk) is nearly twice as large as the other, and is marked with three nerves.

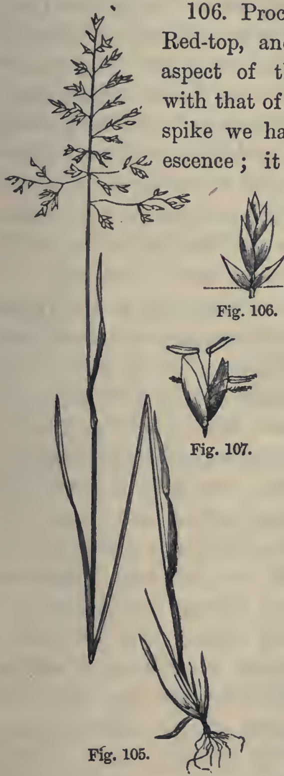
Fig. 105. Fig. 106. Fig. 107.

Fig. 105.—Common Meadow-Grass.
Fig. 106.—Spikelet enlarged, showing the glumes at the base.
Fig. 107.—Single flower of same.

107. Next let us inspect a specimen of the Common Meadow-Grass. The inflorescence of this very common grass (Fig. 105) is a greenish panicle. The spikelets (Fig. 106) contain from three to five flowers, and are laterally compressed. The *glumes* are the lowest pair of scales, and they are generally shorter than the flowers within them. Observe the delicate whitish margin of the lower palet of each flower (Fig. 107), and the thin texture of the upper one. Count also, if you can, the five nerves on the lower palet, and observe the two teeth at the apex of the upper one. In this Grass the principal thing to notice is that *there are several flowers within each pair of glumes.*

108. A common pest in wheat-fields is the Grass known as Chess. It is comparatively easy of examination on account of the size of the spikelets (Fig. 108) and flowers. The spikelets form a spreading panicle, each of them being on a long, slender, nodding pedicel, and containing from eight to ten flowers. Of the two glumes at the base of each spikelet one is considerably larger than the other. The outer or lower palet of each flower is tipped with a bristle or *awn* (Fig. 109), while *the upper palet at length becomes attached to the groove of the oblong grain.* Observe that the *glumes* are not awned.

Fig. 108.

Fig. 109.

109. The Couch Grass is another very common weed in cultivated grounds. In this Grass the spikelets are

Fig. 108.—Spikelet of Chess. Fig. 109.—Single flower. (Gray.)

sessile on opposite sides of the zigzag peduncle, so that the whole forms a spike. Each spikelet is four- to eight-flowered, and there is but one at each joint of the peduncle, the *side* of the spikelet being against the stalk. The glumes are nearly equal in size, and the lower palet of each flower closely resembles the glumes, but is sharp-pointed or awned. The grass spreads rapidly by running root-stocks, and is troublesome to eradicate.

110. Old-Witch Grass is to be found everywhere in sandy soil and in cultivated grounds. The leaves are very hairy, and the panicle very large, compound, and loose, the pedicels being extremely slender. Of the two glumes one is much larger than the other. Unless you are careful you will regard the spikelets as 1-flowered; observe, however, that in addition to the one manifestly perfect flower *there is an extra palet below.* This palet (which is very much like the larger glume) is a rudimentary or abortive second flower, and the spikelet may be described as $1\frac{1}{2}$-flowered.

111. Barnyard Grass is a stout, coarse plant, common in manured soil. It is from one to four feet in height, and branches from the base. The spikelets form dense spikes, and these are crowded in a dense panicle which is rough with stiff hairs. The structure of the spikelets is much the same as in Old-Witch Grass, but the palet of the neutral flower is pointed with a rough awn or bristle.

112. In the common Foxtail the inflorescence is apparently a dense, bristly, cylindrical spike. In reality, however, it is a spiked panicle, the spikelets being much the same as in Barnyard Grass, but their *pedicels* are prolonged beyond them into awn-like bristles. In this

plant the bristles are in clusters and are barbed upwards. *The spikes are tawny-yellow in colour.*

113. These examples, if conscientiously studied with the aid of the plants themselves, will give you a good general idea of the kinds of variation which may be looked for in the Grasses. They may be said, roughly, to consist in the presence or absence of glumes, of awns, and of the upper palet; in the general aspect of the whole flower-cluster; in the number of flowers in the spikelets; and in the varying relative size of the glumes and of the palets.

114. The Order as a whole is distinguished by the following characters:

1. *The sheaths of the leaves are split on the side of the culm opposite the blade.*
2. *The separate flowers are enclosed in glumaceous bracts called palets.*
3. *The perianth is represented by the lodicules.*
4. *The stamens are three in number, and the pistil is syncarpous (two carpels), with a one-celled ovary producing a single seed, which is always albuminous with the embryo on one side.*

CHAPTER XV

COMMON CHARACTERISTICS OF THE PLANTS JUST EXAMINED—STRUCTURE OF THE SEED IN MONOCOTYLEDONS.

115. It is now to be pointed out that the plants examined in the last three chapters, though differing in various particulars, yet have some characters common to all of them, just as the group ending with Maple was

found to be marked by characters possessed by all its members. The flowers of Dicotyledons were found to have their parts, as a rule, in fours or fives; those of our second group have them in *threes* or *sixes*, never in fives.

116. Again, the leaves of these plants are straight-veined, except in Trillium and Indian Turnip, which must be regarded as exceptional, and they do not as a rule exhibit the division into petiole and blade which was found to characterize the Exogens.

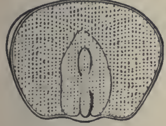

Fig. 110.

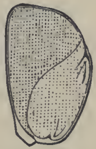

Fig. 112.

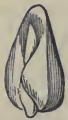

Fig. 111.

117. We shall now compare the structure of a grain of Indian Corn with that of the Cucumber or Pumpkin seed which we have already examined (page 59). It will facilitate our task if we select a grain from an ear which has been boiled. And, first of all, let us observe that the grain consists of something more than the seed. The grain is very much like the achene of the Buttercup, but differs in this respect, that the outer covering of the former is completely united with the seed-coat underneath it, whilst in the latter the true seed easily separates from its covering. Remove the coats of the grain, and what is left is a whitish, starchy-looking substance, having a yellowish body inserted in a hollow (Fig. 110) in the middle of one side. This latter body is the *embryo*, and may be easily removed. All the rest is *albumen*. Fig. 111 is a front view of the embryo, and Fig. 112 shows a vertical section of the same. The greater part of the

Figs. 110, 111, 112.—Sections of a grain of Indian Corn. (Gray.)

embryo consists of a *single cotyledon.* The radicle is seen near the base, and the plumule above. Compare an Oat (Fig. 113) with the grain of Corn and make out the corresponding parts. In all essential particulars they are alike.

118. Comparing the result of our observations with what we have already learned about the Cucumber seed, we find that whilst in the latter there are *two* cotyledons, in the present case there is but *one*, and this peculiarity is common to all the plants just examined, and to a vast number of others besides, which are consequently designated **Monocotyledonous** plants, or shortly **Monocotyledons.** The seeds of this great group may differ as to the presence or absence of albumen, just as the seeds of Dicotyledons do, but in the *number* of their cotyledons they are all alike. The Orchids, however, are very peculiar from having no cotyledons at all.

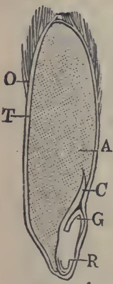

Fig. 113.

119. In addition to the points just mentioned, viz : the number of floral leaves, the veining of the foliage leaves,the usual absence of distinct petioles, and the single cotyledon, which characterize our second great group, there is still another, as constant as any of these, and that is, the mode of growth of the stem, which is quite at variance with that exhibited in Dicotyledonous plants. In the present group the increase in the thickness of the stem is accomplished not by the deposition of circle after circle of new wood outside the old, but by the production of new wood-fibres through the interior of the stem generally. These stems are therefore said to be

Fig. 113. — Vertical section of Oat grain ; R, radicle ; G, plumule ; C, cotyledon ; A, albumen (or endosperm) ; O, hairs ; T, testa. (Thomé.)

endogenous, and the plants composing the group are called **Endogens,** as well as **Monocotyledons.** The term Endogen, however, is used in quite a different sense by some recent botanists, and is discarded by them as a synonym for monocotyledon, as having been given originally under a misconception as to the true mode of growth of the wood in stems of this kind. We shall explain more fully the structure of exogenous and endogenous stems when we come to speak of the minute structure of plants in a subsequent chapter.

120. The typical flower of the Monocotyledons is that of the Lily ; it consists of five whorls, two belonging to the perianth, two to the anthers, and one to the pistil. Other flowers of the group, as we have seen, exhibit departures from the type, chiefly in the suppression of whorls or parts of whorls. Thus in the Iris one whorl of stamens is suppressed. In this plant, also, the ovary is *inferior.* In the spadiceous plants the perianth is suppressed, and in the Grasses there may be suppression in all the whorls.

CHAPTER XVI.

EXAMINATION OF CONIFEROUS PLANTS—WHITE PINE—GROUND-HEMLOCK.

121. The cone-bearing trees are so striking and important a feature in Canadian vegetation that even an elementary work like the present would be incomplete without a notice of them. They form, besides, a very distinct group of plants, intermediate in structure, as we shall see, between the groups upon which we have so far been

Fig. 115.

Fig. 114.

engaged and others to which we shall presently direct attention.

122. As perhaps the commonest Canadian type of the Coniferous Group, the White Pine first demands our attention. This noble tree, in its general aspect, is familiar to every one. It produces a straight trunk, which is continued upward year after year by the development of a strong terminal bud, the new branches of each year being developed from a circle of lateral buds formed behind the apex of the stem or old branch. The general aspect of the tree, therefore, unless it is a very old one, is that of a broad-based cone or spire. The leaves are straight

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Fig. 114.—Leaves and cluster of staminate catkins of White Pine. (Wood and Steele.)

Fig. 115.—Pollen-grain of Pine. (Wood and Steele.)

needles, and are produced in clusters of five each. In the Red Pine, on the other hand, there are but two leaves in the cluster. Other species have bundles of three each. These leaves, as is well known, are *evergreen*, that is to say, they do not perish in the first autumn, but persist through the winter and until the new leaves of the following season are fully developed.

123. The flowers of the Pine must be looked for in spring just before the new leaves are put forth. They are monœcious or diœcious. The staminate flowers, consisting of a single stamen each, are produced around the bases of the new shoots, where they form dense clusters of small catkins (Fig. 114). Each anther is two-celled, and the pollen-grains (Fig. 115) are rather peculiar in shape, having, in fact, the appearance of three grains cohering together. The two outer portions, however, are only bladder-like developments of the outer coat *(extine)* of the real grain, which occupies the centre.

Fig. 116.

124. The pistillate or fertile flowers are aggregated together upon an elongated axis, forming in fact the well-known *cone* of the Pine (Fig. 116). The young cones will be found to occupy lateral positions on the branches; each of them is made up of many spirally arranged *scales*, each scale being in the axil of a bract (Fig. 117). At the base of each scale, on the inside, will be found two ovules turned downwards (Fig. 118). Observe that these ovules *are not enclosed in an ovary.* Because of this fact the group of plants of which the Pine is a type is said to be

Fig. 116.—Cone of Pine. (Wood and Steele.)

gymnospermous, that is, naked-seeded. All the plants previously examined, on the other hand, have their seeds enclosed in ovaries; hence they are all *angiospermous*. The scales of the cone are to be regarded as open carpellary leaves, and each of them, with its pair of ovules, constitutes a fertile flower. The pollen is carried by the wind directly to the micropyle of the ovule, there being no intervening stigma; but, as the quantity of pollen produced is immense, the chances of failure to reach the ovules are very slight. At the time of pollination, the air in a pine forest is full of pollen. The yellow scum often found on water after a summer shower is chiefly Pine pollen. After fertilization the ovules develope into seeds, and the scales of the cone, which are originally of rather soft texture, attain a woody consistency. This process of maturing, however, in the Pine takes considerable time. The cones do not ripen until the autumn of the second year, after flowering. At this time the scales diverge from the axis, and the seeds are allowed to escape, each of them being now furnished with a wing, which enables the wind more readily to waft it away.

Fig. 117.

Fig. 118.

The number of cotyledons in the embryo is variable, but is always more than two; sometimes there are as many as twelve.

The wood of the Gymnosperms is essentially like that of the Dicotyledons, and the stem thickens in the same way. Certain differences will be noticed in another place.

Fig. 119.

Fig. 117.—Single scale of Pine cone with its bract. (Wood and Steele.)
Fig. 118.—Inner side of the scale, showing the two naked ovules. (Wood and Steele.)
Fig. 119.—Staminate catkins of Ground Hemlock.

125. It will be interesting now to compare with the structure of the Pine that of another member of the same group—the Ground Hemlock, a low shrub common enough in our Canadian woods. This, like the Pine, is evergreen. The leaves, however, are not needle-shaped, but flat; and they are not clustered, but project singly from the sides of the stem.

126. The staminate flowers (Fig. 119) grow in small catkins at the ends of very short lateral shoots which bear about their bases many scale-like bracts. The stamens are somewhat different from those of Pine, being umbrella-shaped (peltate), and bearing from three to eight pollen-sacs upon the under surface. The fertile flowers are also at the extremities of short, scaly-bracted branches, but in this plant the flowers occur singly, and are not aggregated in cones. Fig. 120 shows a section of a fertile branch with its bracts and the single naked ovule at its extremity. Around the base of the ovule there is a fleshy ring or disk (shown in section at *a* in the figure). The pollen is conveyed by the wind directly to the micropyle, and after fertilization, and during the development of the seed, the fleshy ring upon which it rests grows upward so as to surround the seed and give the fruit a remarkable berry-like appearance (Fig. 121). This fleshy covering (which is

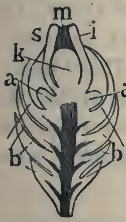


Fig. 120.

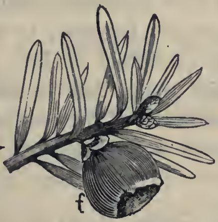


Fig. 121.

Fig. 120.—Section of fertile branch of Ground Hemlock; *s*, the apparently terminal ovule; *i*, its integument; *k*, the nucellus; *m*, the micropyle; *a a*, the rudiment of the aril, which finally surrounds the seed; *b b*, bracts. (Prantl).

Fig. 121.—The same with mature fruit, *f*. (Prantl).

bright red at maturity) is a good example of what is called an *aril.*

127. We find, then, that although there is at first sight little in common, apparently, between the cone of the Pine and the berry-like fruit of the Ground Hemlock (*Taxus baccata*), yet they both have the characteristic *naked ovules.*

128. Among our cone-bearing trees will readily be recognized the Arbor Vitæ (commonly called Cedar), the Larch or Tamarack, which, however, is not evergreen, and the various kinds of Spruce or Fir. The Juniper, also, belongs to this group, but is marked by the peculiarity that the few scales of the cone cohere together in ripening and become succulent, thus forming what looks like a berry.

129. To sum up the results of our observations upon plant-structure, we have found

(1) That all the plants to which our attention has so far been directed *produce flowers ;* they are all, therefore, flowering or *phanerogamous* plants, or, briefly, *phanerogams.*

(2) That in a large number of the plants there are ovaries enclosing the seeds. All such plants are grouped as *angiosperms.*

(3) That in others the seeds are not enclosed in an ovary. Hence we have a group known as *gymnosperms.*

(4) That the angiosperms are either *dicotyledonous* or *monocotyledonous.*

These conclusions may be conveniently shown in a tabular form as follows:

- PHANEROGAMS.
  - ANGIOSPERMS.
    - DICOTYLEDONS.
    - MONOCOTYLEDONS.
  - GYMNOSPERMS.

CHAPTER XVII.

MORPHOLOGY OF ROOTS, STEMS, AND FOLIAGE-LEAVES OF PHANEROGAMS.

130. Before proceeding with the examination of other selected plants illustrative of other divisions of the vegetable kingdom, we shall present in a systematic way the more important facts in connection with the Phanerogams, dealing in turn with the organs of vegetation—the root, the stem, and the foliage-leaves—and then with the organs of reproduction as displayed in the flower. The various forms assumed by these organs, whether in different plants or in different parts of the same plant, will have our attention, as also their various modes of arrangement. We shall consider, also, rather more minutely than we have hitherto been able to do, the development of the seed from the ovule, the process of pollination and of fertilization, and the subsequent germination of the seed and development of the new plant. To this study of forms the name *Morphology* has been given. It need hardly be said that effective morphological work can only be accomplished by actual

contact with and inspection of the forms which are, for the time being, the objects of study. The young student must provide himself with specimens, and learn to associate the descriptive terms with the actual condition which the terms describe. Only in this way can this branch of botanical work be relieved of the element of drudgery, and made what it ought to be—a means of developing in a high degree those powers of observation with which the young are so exceptionally endowed. It is believed that with proper management even the more difficult technical terms, which are derived from Latin and Greek, and specially devised for botanical purposes, will be learned without extraordinary effort. It is the writer's experience that a term is insensibly acquired and almost indelibly impressed upon the mind *if there is first created the want of the term* to describe what is seen when some new form has been the subject of observation, and its peculiarities have been thoroughly grasped through the medium of the eye. With a good many of the terms there will be found no difficulty whatever, since they have the same meaning in their botanical applications as they have in their every-day use.

131. **The Root.** This organ is called the descending axis of the plant, from its tendency to grow downward into the soil from the very commencement of its development. Its chief use is to imbibe liquid nourishment, and transmit it to the stem, from which it is well distinguished by the presence of the root-cap (Fig. 122, *a*) and the absence of leaves. The absorbing surface of a young root or rootlet is largely increased by the development of *root-hairs*, the nature of which will be explained later on when we come to treat of trichomes or hair-like growths

generally. It must be mentioned here, also, that there are some exceptions to the general statement that roots do not produce buds. It is well known that new stems are sent up by the roots of Poplars and of Apple trees, for example, especially if the roots have been injured. These cases must be regarded as abnormal.

Fig. 122.

132. You will remember that in our examination of some common seeds, such as those of the Pumpkin and Bean (Figs. 77–81), we found at the junction of the cotyledons a small pointed projection called the *radicle*. Now, when such a seed is put into the ground, under favorable circumstances of warmth and moisture, it begins to grow or *germinate*, and the radicle, which in reality is a minute stem, not only lengthens, in most cases, so as to push the cotyledons upwards, but developes a *root* from its lower extremity. All seeds, in short, when they germinate, produce roots from the extremity of the radicle, and *in a direct line with it*, and roots so produced are called *primary roots*. In Monocotyledons the primary root is but very slightly developed, the fibrous roots characteristic of these plants bursting forth *from the sides* of the radicle at an early period of growth. In other plants the primary root either assumes the form of a distinct central axis larger than any of its branches, and called a *tap-root* (Fig. 123), examples of which are furnished by the Mallow, the Carrot, and the

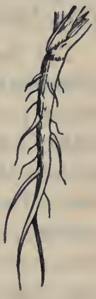


Fig. 123.

Fig. 122.—Magnified tip of Hyacinth root; *a*, the root-cap. (Hooker.)
Fig. 123.—Tap-root of Dandelion.

Bean, or it may *branch* at an early stage into numerous similar threads, and so form a fibrous root, as in Buttercup.

133. Tap-roots receive different names according to the particular shape they happen to assume. Thus, the Carrot (Fig. 124) is *conical*, because from a broad top it tapers gradually and regularly to a point. The Radish, being somewhat thicker at the middle than at either end, is *spindle-shaped*. The Turnip, and roots of similar shape, are *napiform* (*napus*, a turnip).

Fig. 124.

These fleshy tap-roots belong, as a rule, to biennial plants, and are designed as storehouses of food for the plant's use during its second year's growth. Occasionally fibrous roots also thicken in the same manner, as in the Peony, and then they are said to be *fascicled* or *clustered*. (Fig. 125).

Fig. 125.

134. But you must have observed that plants sometimes put forth roots in addition to those developed from the embryo of the seed. The Verbena of our gardens, for example, will take root at every joint if the stem be laid upon the ground (Fig. 126). The runners of the Strawberry take root at their extremities; and nothing is more familiar than that cuttings from various plants will make roots for themselves if put into proper soil, and supplied with warmth and moisture.

Fig. 124.—Tap-root of Carrot. Fig. 125.—Fascicled roots of Peony.

All such roots, not developed from the end of the radicle and in a straight line with it, are called *secondary* or *adventitious* roots. Under this head should, of course, be placed the fibrous roots of all Monocotyledonous plants, the true primary roots of which are but very feebly developed. So, also, all branches of primary roots should be regarded as adventitious. When such roots are developed from parts of the stem which are not in contact with the ground, they are *aerial*, as, for example, the roots developed from the lower joints of the stem of Indian Corn.

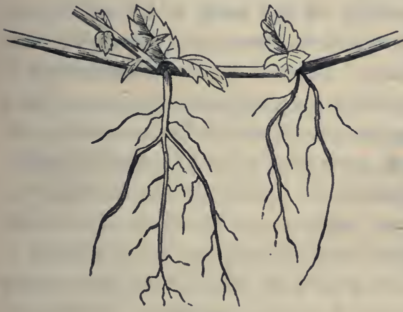


Fig. 126.

135. There are a few curious plants whose roots never reach the ground at all, and which depend altogether upon the air for food. These are called *epiphytes.* There are others whose roots penetrate the stems and roots of other living plants, and thus receive their nourishment as it were at second-hand. These are *parasitic* plants. The Dodder and Beech-drops, of Canadian woods, are well-known examples. Others, again, subsist upon decomposing animal or vegetable matter, and are hence known as *saprophytes.* Indian Pipe and Coral-root are good examples of saprophytic plants. Both parasites and saprophytes are usually destitute of green leaves,

Fig. 126.—Adventitious roots of Verbena.

being either pale or brownish. The Mistletoe, however, is a green parasite.

136. As to duration, roots (and, consequently, the plants themselves) are either *annual*, or *biennial*, or *perennial*. The plant is called an annual if its whole life, from the germination of the seed, is limited to one season. It is biennial if it flowers and ripens its seed in the second season. Between these two classes it is difficult to draw a sharp line, because, with proper care, some annuals may be induced to live for two years; and, on the other hand, some plants, as the Radish, which are properly biennial if the seed is sown in the fall, will flower and produce seed in one season if sown in the spring. Something, also, depends upon the climate in which the plant is grown, its life, in some cases, being prolonged in a more favourable situation. Perennials live on year after year, as is the case with all our shrubs and trees, and also with some herbaceous plants, as Peony and Dahlia, which only die down to the surface of the ground in the autumn.

137. **The Stem.** As the root is developed from the lower end of the radicle of the embryo, so the stem is developed from the upper end, but with this important difference, that a *bud* always precedes the formation of the stem or any part of it or its branches. If a bud, such as that of the Lilac, be picked to pieces, it will be found to consist mostly of minute leaves closely packed together on a short bit of stem. A bud, in fact, is only a special condition of the extremity of the stem, and is not to be regarded as an organ distinct from it. As the bud unfolds, the stem may lengthen so as to exhibit the internodes, or

it may remain short, in which case the expanded leaves form a cluster or rosette, as in Dandelion. The tender leaves of the bud are not uncommonly protected from the weather by coverings in the form of tough scales, with the additional safeguard sometimes of a wax-like coating on the surface of the latter, as seen in the conspicuous buds of the Horse-Chestnut, and the cap-like coverings of those of the Spruce.

138. Between the cotyledons of the Bean (Fig. 81), at the top of the radicle, we found a minute bud called the *plumule.* Out of this bud the first bit of stem is developed (leaving out of consideration the radicle itself), and during the subsequent growth of the plant, wherever a branch is to be formed or a main stem to be prolonged, there a bud will invariably be found. The branch buds are always in the axils of leaves, and so are called *axillary*, and it not uncommonly happens that several buds are found together in this situation.

139. *Adventitious* buds, however, are sometimes produced in plants like the Willow, particularly if the stem has been wounded. As already mentioned, they are also occasionally produced upon roots, as, for example, upon those of the Poplars.

140. The bud from which the main stem is developed, or a branch continued, is of course at the end of the stem or branch, and so is *terminal.*

141. **Branching** or **Ramification.** By a branch is meant an off-shoot similar in structure to the member from which it springs. Hence the side-shoots of roots are root-branches ; so, also, the lateral out-growths of the stem which resemble the stem itself in structure are

stem-branches. It is found that the branching of stems proceeds upon two well defined plans.

142. *Monopodial Branching.* This system is distinguished by the circumstance that all the branches are the result of the development of strictly lateral buds. In other words, there is invariably a terminal bud at the apex of the stem distinct from the lateral buds produced behind the apex. Of this system there are several

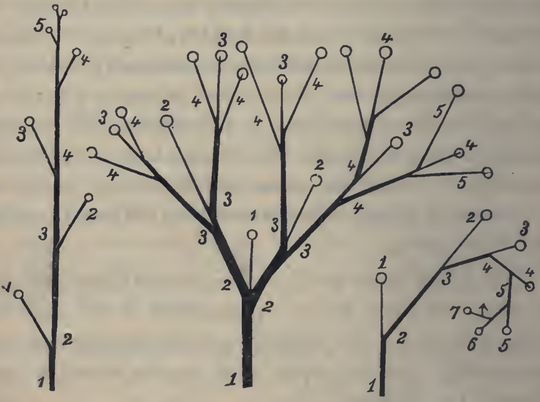


Fig. 130. Fig. 127. Fig. 128.

modifications. If the terminal bud develops regularly, as well as the lateral ones, it is clear that we shall have a straight and well-defined trunk, easily distinguished by its vigorous growth from the branches. The Pine or the Spruce is an excellent example of this effect.

Figs. 127, 128, 130.—Diagrams of various forms of monopodial branching. (Sachs.)

But if the terminal bud, though produced, ceases to grow, while the lateral buds are vigorously developed, as is well exhibited in the spring by the annual shoots of the Lilac, then it is clear that the branches will overtop the original stem, and the latter will finally become unrecognizable.

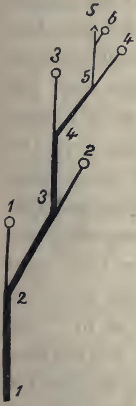


Fig. 129.

143. The Pine and the Spruce and similar forms are said to be *racemose* or *botryose*, and the Lilac, in the development of its annual shoots, is said to be *cymose.* Fig. 127 is a representation of the latter mode. Here 1 is the extremity of the main stem, but the terminal bud at that point has failed to grow, while two vigorous branches have been produced. The terminal buds of these branches (2 and 2), have in their turn failed, and the laterals immediately behind them have, as before, given rise to new shoots. This is the result, then, when both the lateral buds grow with equal vigour, and it is known as a *forked cyme.*

144. But sometimes one member of each pair of buds is developed far more strongly than the other. If the strong buds are developed in succession on the same side of the stem an effect will be produced like that represented in Fig. 128. This is known as a *helicoid* cyme. If, however, the strong buds are developed alternately on both sides of the stem, we get the form shown in Fig. 129, which is then called a *scorpioid* cyme. Not un-

Fig. 129.—Diagram to illustrate scorpioid cyme. (Sachs.)

commonly this latter form becomes straightened out, as in Fig. 130, so that the successive branches are in the same line, and look like a stem developed from the terminal bud. As the *foot* or support is not in this case the continuation of a single axis, but is made up of a number of successive branches superposed, these forms are said to be *sympodial*, the prefix in this term having the same significance as in "syncarpous" and the like, and implying that the foot is composed of several coherent parts. In these cases, then, we have a *sympodial monopodium.*

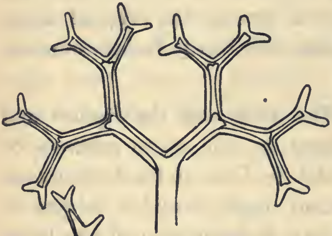


Fig. 131.

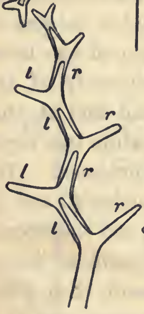


Fig. 133.

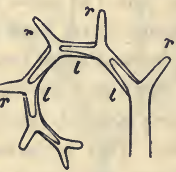


Fig. 132.

145. *Dichotomous Branching.* In this system the growing point at the apex of the stem *divides into two new growing points*, both of which are, therefore, *terminal* and not lateral, as in the first mode. The growing points of the branches, in their turn, are each converted into two new ones, as shown in Fig. 131. As in the monopodial mode, there may be helicoid and scorpioid dichotomy, due to the superior development of the growing points on

Figs. 131, 132, and 133.—Diagrams to illustrate dichotomous branching. (Sachs.)

one side, or on alternate sides of the stem, as shown in Figs. 132 and 133. These forms are, of course, sympodial.

146. A comparison of Figs. 127 and 131 will show that there is a superficial resemblance between the forms. On this account the forked cyme is sometimes referred to as a *dichasium* or *false dichotomy.*

147. Dichotomous branching is rare, but occurs in the roots of Club-Mosses, and in Lichens. In the phanerogams, monopodial branching is the almost invariable rule. The flowering stems, which afford the best illustrations, will be referred to hereafter.

148. If you examine a few stems of plants at random, you will probably find some of them quite soft and easily compressible, while others will be firm and will resist compression. The stem of a Beech or a Currant is an instance of the latter kind, and any weed will serve to illustrate the former. The Beech and the Currant have *woody* stems, while the weeds are *herbaceous.* Between the Beech and the Currant the chief difference is in size. The Beech is a *tree,* the Currant a *shrub.* But you are not to suppose that there is a hard and fast line between shrubs and trees, or between herbs and shrubs. A series of plants could be constructed, commencing with an unquestionable herb and ending with an unquestionable tree, but embracing plants exhibiting such a gradual transition from herbs to shrubs and from shrubs to trees, that you could not say at what precise point in the series the changes occurred.

149. The forms assumed by stems above ground are numerous, and they are described mostly by terms in common use. For instance, if a stem is weak and trails

along the ground, it is *trailing* or *prostrate ;* and if, as in the runners of the Strawberry, it takes root on the lower side, then it is *creeping.* Such a shoot as the runner of the Strawberry, which takes root at a distance from the parent plant, is commonly called a *stolon.*

Fig. 134.

150. Many weak stems raise themselves by clinging to any support that may happen to be within their reach. In some instances the stem itself winds round the support, assuming a spiral form, as in the Morning-Glory, the Hop, and the Bean, and is therefore distinguished as *twining.* In other cases the stem puts forth thread-like leafless branches called *tendrils* (Fig. 134), which grasp the support, as in the Virginia Creeper and the Grape. In the Pea, the end of the extended mid-rib of the leaf is transformed into a tendril (Fig. 135). Sometimes the leaf-stalks themselves serve the same purpose, as in the Clematis or Virgin's Bower. In these cases the stems are said to *climb.* Our Poison Ivy climbs over logs, &c., by the aid of its aerial roots.

Fig. 135.

The stems of wheat and grasses generally are known as

Fig. 134.—Leaf and tendril of Grape-vine.
Fig. 135—Tendril of the Pea.

culms. They are jointed, and usually hollow except at the joints.

151. Besides the stems which grow above ground, there are varieties to be found below the surface. Pull up a Potato plant, and examine the underground portion (Fig. 136). It is not improbable that you will regard the whole as a mass of roots, but a very little trouble will undeceive you. Many of the fibres are unquestionably

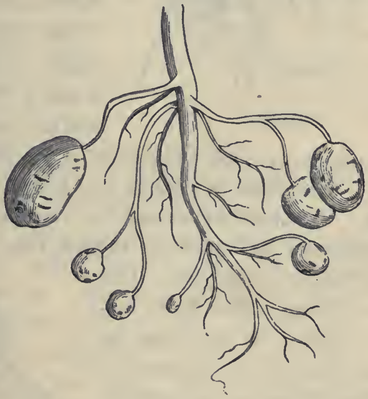


Fig. 136.

roots, but an inspection of those having potatoes at the ends of them will show you that they are quite different from those which have not. The former will be found to be furnished with little scales, answering to leaves, each with a minute bud in the axil; and the potatoes themselves exhibit buds of the same kind. The potato, in short, is only *the swollen end of an underground stem.* Such swollen extremities are known as *tubers*, whilst the

Fig. 136.—Tubers of the Potato.

underground stem is called a *root-stock* or *rhizome*, and may almost always be distinguished from a true root by the presence of buds. The Solomon's Seal and Toothwort of Canadian woods, and the Canada Thistle, are common instances of plants producing these stems. Fig. 137 shows a rhizome.

Fig. 137.

152. Take now an Onion, and compare it with a Potato. You will not find any such outside appearances upon the former as are presented by the latter. The Onion is smooth, and has no buds upon its surface. From the under side there spring roots, and this circumstance will probably suggest that the Onion must be a stem of some sort. Cut the Onion through from top to bottom (Fig. 138). It will then be seen to be made up of a number of coats. Strip off one or two, and observe that whilst they are somewhat fleshy where the Onion is broadest, they gradually become thinner towards the top. The long, green tubes which project from the top of the Onion during its growth are, in fact, the prolongations of these coats. But the tubes are the leaves of the plant itself. The mass of our Onion, therefore, consists

Fig. 138.

Fig. 137.—A rhizome.
Fig. 138.—Vertical section of bulb of the Onion.

of the *fleshy bases of the leaves.* But you will observe that at the bottom there is a rather flat, solid part upon which these coats or leaves are inserted, and which must consequently be a stem. Such a stem as this, with its fleshy leaves, is called a *bulb.* If the leaves form coats, as in the Onion, the bulb is *coated* or *tunicated;* if they do not, as in the Lilies (Fig. 139), it is *scaly.*


Fig. 139.

153. Tubers and bulbs, then, consist chiefly of masses of nourishing matter; but there is this difference, that in the latter the nourishment is contained in the fleshy leaves themselves, whilst in the former it forms a mass more or less distinct from the buds.

154. The thickened mass at the base of the stem of our Indian Turnip (Fig. 94) is more like a tuber than a bulb in its construction. It is called a *corm* or solid bulb. The Crocus and Gladiolus of the gardens are other examples. The chief difference between the corm and the ordinary bulb is in the relative space occupied by the stem or solid part. In the former it is very much greater than in the latter. The student should dissect specimens of Indian Turnip, Crocus, Tulip, Hyacinth, &c., when these differences will be readily apprehended.

155. In the axils of the leaves of the Tiger Lily are produced small, black, rounded bodies, which, on examination, prove to be of bulbous structure. They are, in fact, *bulblets*, and new plants may be grown from them.

156. **Foliage-Leaves.** These organs are usually more or less flat, and of a green colour. In some plants,

Fig. 139.—Bulb of a Lily.

however, they are extremely thick and succulent; and in the case of parasites and saprophytes, such as Indian Pipe and Beech-drops, they are usually either white or brown, or of some colour other than green. The scaly leaves of underground stems are also, of course, destitute of colour. The green colour is due to the presence of granular particles of a substance called *chlorophyll*. It is formed, as a rule, only in those parts which are exposed to the action of sunlight, and it is intimately connected with the process of assimilating nutritious matter for the plant's use during growth. Further reference will be made to it later on.

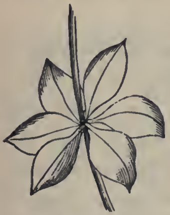


Fig. 140.

157. As a general thing, leaves are extended horizontally from the stem or branch, and turn one side towards the sky and the other towards the ground. But some leaves are *vertical*, and in the case of the common Iris (Figs. 88 and 89) each leaf is doubled lengthwise at the base, and *sits astride* the next one within. Such leaves are called *equitant*.

158. **Phyllotaxis** or **Leaf-Arrangement**. As to their arrangement on the stem, leaves are *alternate* when only one arises from each node (Fig. 3). If two are formed at each node, they are sure to be on opposite sides of the stem, and so are described as *opposite*. If, as in Mint and Maple, each pair of opposite leaves stands at right angles to the next pair above, then the arrangement is *decussate*. Sometimes there are several leaves at the same node, in which case they are *whorled* or *verticillate* (Fig. 140).

Fig. 140.—Whorled leaves of Galium.

159. Even if the leaves are placed singly and apparently irregularly at intervals along the stem, it will be found on examination that their arrangement is governed by definite laws. Take, for instance, a branch of Poplar with a number of leaves upon it. Fix upon any one leaf near the lower end of the branch, and then from its point of insertion draw a line, *by the nearest way*, to the insertion of the next higher leaf, and from this to the next, and so on till you reach a leaf which is exactly over the first one. If the branch itself has not been twisted out of its normal shape, it will be found that the *sixth* leaf is always precisely over the first, the seventh over the second, the eighth over the third, and so on, and that the line joining the points of insertion of successive leaves forms a spiral round the stem. It will also be found that this spiral goes *twice* round the stem before passing through the sixth leaf. The sixth leaf, as standing exactly over the first, begins a new set, which lasts in a similar manner till we reach the eleventh. The leaves are therefore in sets or cycles of five each, and the phyllotaxis in this case is conveniently described by the fraction $\frac{2}{5}$, the denominator of which gives the number of leaves in the cycle, and the numerator the number of turns in the spiral.

160. Now, if through the insertions of the leaves which are vertically over each other—that is, through those numbered 1, 6, 11, 16, etc., and then through those numbered 2, 7, 12, 17, and so on—lines be drawn, it is evident we shall have five such vertical lines on the stem. These lines mark the *ranks* of leaves, or *orthostichies.* The number of orthostichies in any case always corresponds to the number of leaves in the cycle.

161. In the Elm, the phyllotaxis is much simpler. Here, starting with any given leaf, it will be found that the next one is exactly half way round the circumference of the stem, and the third one exactly over the first, and so on. So that the spiral completes the circuit in one turn, and the number of orthostichies is only two, the phyllotaxis being therefore described as $\frac{1}{2}$. The $\frac{1}{3}$ arrangement is also common. The Poplar, as we see, has a $\frac{2}{5}$ arrangement; this is extremely common.

162. If we set down these fractions in order, thus: $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, it will be noticed that the sum of the first two numerators gives the third numerator; so also with the denominators. If we proceed to make other fractions in this way, the series would read $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{5}$, $\frac{3}{8}$, $\frac{5}{13}$, $\frac{8}{21}$, $\frac{13}{34}$, and these are, as it happens, the actual cases of phyllotaxy which we commonly meet with. The cone of the White Pine furnishes a very good exercise. In this case the scales (which, of course, are leaf-forms) have a $\frac{5}{13}$ arrangement.

163. The conclusion come to from a close examination of the incipient buds is, that the newer leaves are produced over the widest intervals between those next below. In short, the arrangement is that which secures to the leaves the most advantageous conditions for exposure to the light, and at the same time economizes space. As has been aptly said, the growth of the new leaves follows the "lines of least resistance."

164. When leaves are in whorls instead of in spirals, the members of any whorl stand over the spaces of the whorl below, as might be expected. As to leaves which are clustered or fascicled, like those of the Pine and Larch, it may be pointed out that the clustering is due simply to

the non-development of internodes. The clusters when carefully examined, show in some cases an alternate, and in others a whorled, arrangement.

165. As branches are produced in the axils of leaves, it is clear that the arrangement of branches will be the same as that of the leaves. It rarely happens, however, that all the buds develope into branches. Many of them fail, so that generally branches appear to have no very definite arrangement.

166. **Vernation** or **Præfoliation.** These terms have reference to the mode in which the new leaves are folded in the bud. Very commonly the leaf is simply doubled lengthwise, the upper side of the leaf within; then its vernation is said to be *conduplicate.* In the Maple and Mallow the folding is fan-like, and is described as *plaited.* In the Cherry the leaf is coiled in a single coil beginning with one edge: this is *convolute* vernation; but if the coiling is from both edges to the mid rib, it is said to be *involute;* if both edges are rolled backward, it is *revolute.* The vernation is *circinate* when the leaf is coiled from the tip, as in Ferns.

167. **Forms of Foliage-Leaves.** Leaves present an almost endless variety in their forms, and accuracy in describing any given leaf depends a good deal upon the ingenuity of the student in selecting and combining terms. The chief terms in use will be given here.

Compare a leaf of the Round-leaved Mallow with one of Red Clover (Figs. 141, 142). Each of them is furnished with a long petiole and a pair of stipules. In the blade, however, there is a difference. The blade of the former consists of a *single piece;* that of the latter is in three separate pieces, each of which is called a *leaflet*, but all of which, taken collectively, constitute the blade of the *leaf*. The leaf of the Mallow is **simple**; that of the Clover is **compound.** Between the simple and the compound form there is every possible shade of gradation. In the Mallow leaf the *lobes* are not very clearly defined. In the Maple (Fig. 143) they are well

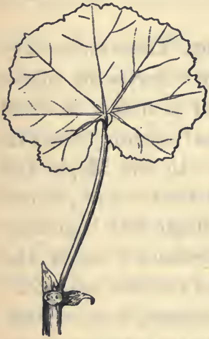


Fig. 141.

Fig. 142.

marked. In other cases, again, the lobes are so nearly separate that the leaves appear at first sight to be really compound.

168. You will remember that in our examinations of dicotyledonous plants, we found the leaves to be invariably net-veined. But, though they have this general character in common, they differ considerably in the details of their veining, or **venation,** as it is called. The two leaves employed as illustrations in the last section will

Fig. 141.—Simple palmately-veined leaf of Mallow.
Fig. 142.—Compound leaf of Clover.

serve to illustrate our meaning here. In the Mallow,

Fig. 143.

there are several ribs of about the same size, radiating from the end of the petiole, something like the spread-out fingers of a hand. The veining in this case is therefore described as *digitate*, or *radiate*, or *palmate*. The *leaflet* of the Clover, on the other hand, is divided exactly in the middle by a single rib (the *mid-rib*), and from this the veins are given off on each side, so that the veining, on the whole, presents the appearance of a feather, and is, therefore, described as *pinnate* (*penna*, a feather).

169. Both simple and compound leaves exhibit these two modes of venation. Of simple pinnately-veined leaves, the Beech, Mullein, and Willow supply familiar instances. The Mallow, Maple, Grape, Currant, and Gooseberry have simple radiate-veined leaves. Sweet-Brier (Fig. 43), Mountain Ash, and Rose have compound pinnate leaves, whilst those of Virginia-

Fig. 144.

Creeper (Fig. 144), Horse-Chest-nut, and Hemp are compound digitate.

Fig. 143.—Palmately-lobed leaf of Maple.

Fig. 144.—Palmate leaf of Virginia Creeper.

As has already been pointed out, the leaves of Monocotyledonous plants are almost invariably straight-veined.

170. In addition to the venation, the description of a

Fig. 145.

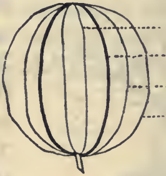


Fig. 146.

simple leaf includes particulars concerning: (1) the **general outline**, (2) the **edge** or **margin**, (3) the **point** or **apex**, (4) the **base**.

171. **Outline.** As to outline, it will be convenient to consider first the forms assumed by leaves without lobes,

Fig. 147.

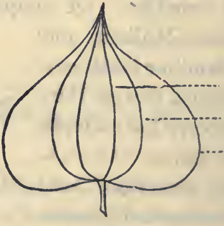


Fig. 148.

and whose margins are therefore more or less continuous. Such leaves are of three sorts, viz.: those in which both ends of the leaf are alike, those in which the apex is

Figs. 145 to 148.—Various forms of foliage-leaves.

narrower than the base, and those in which the apex is broader than the base.

172. In the first of these three classes it is evident that any variation in the outline will depend altogether on the

Fig. 152. Fig. 153. Fig. 149. Fig. 150. Fig. 151.

relation between the length and the breadth of the leaf. When the leaf is extremely narrow in comparison with its length, as in the Pine, it is *acicular* or *needle-shaped* (Fig. 145). As the width increases, we pass through the forms known as *linear*, *oblong*, *oval*, and finally *orbicular*, in which the width and length are nearly or quite equal (Fig. 146).

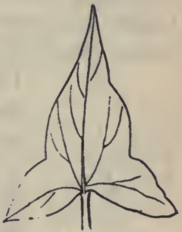


Fig. 154.

173. In the second class the different forms arise from the varying width of the base of the leaf, and we thus have *subulate* or *awl-shaped* (Fig. 147), *lanceolate*, *ovate*, and *deltoid* leaves (Fig. 148).

Figs. 149 to 154.—Various forms of foliage-leaves.

174. In the third class, as the apex expands, we have the forms *spathulate* (Fig. 149), *oblanceolate*—that is, the reverse of lanceolate (Fig. 150), and *obovate* (Fig. 151).

175. In leaves of the second kind we frequently find the base indented, and then the leaf is *cordate* or *heart-*

Fig. 155.

Fig. 156.

Fig. 157.

shaped (Fig. 152). The reverse of this—that is, when the indentation is at the apex—is *obcordate* (Fig. 153). The *hastate* or spear-shaped (Fig. 154), *sagittate* or arrow-shaped (Fig. 155), and *reniform* or kidney-shaped (Fig. 156) forms are modifications of the second class, and will be readily understood from the annexed figures.

Fig. 158.

If the petiole is attached to any part of the under surface of the leaf, instead of to the edge, the leaf is *peltate* (shield-shaped) (Fig. 158).

176. Leaves which are lobed are usually described by stating whether they are palmately or pinnately veined; and

Figs. 155 to 158.—Various forms of foliage-leaves.

if the former, the number of lobes is generally given. If the leaves are very deeply cut, they are said to be *palmatifid* or *pinnatifid*, according to the veining (Fig. 159). If the leaf is pinnatifid and the lobes point backwards towards the base, as in Dandelion, the leaf is said to be *runcinate.* If theleaf is palmately lobed, and the lobes at the base are themselves lobed, the leaf is *pedate* (Fig. 160), because it looks something like a bird's foot. If the lobes of a pinnatifid leaf are themselves lobed, the leaf is *bipinnatifid.* If the leaf is cut up into fine segments, as in Dicentra, it is said to be *multifid.*

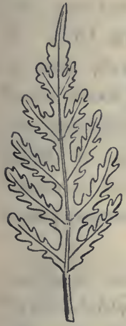


Fig. 159.

177. **Apex.** The principal forms of the apex are the *mucronate* (Fig. 157), when the leaf is tipped with a sharp point, as though the mid-rib were projecting beyond the blade; *cuspidate*, when the leaf ends abruptly in a very short, but distinctly tapering, point (Fig. 161); *acute*, or sharp; and *obtuse*, or blunt.

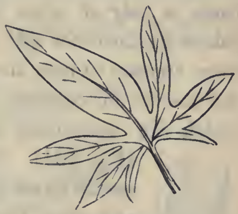


Fig. 160.

Fig. 161.

It may happen that the apex does not end in a point of any kind. If it looks as though the end had been cut off square, it is *truncate.* If the end is slightly notched, but not sufficiently so to warrant the description obcordate, it is *emarginate.*

178. **Margin.** If the margin is not indented in any way, it is said to be *entire.* If it has sharp teeth, *pointing*

Figs. 159 to 161.—Various forms of foliage-leaves.

in the direction of the apex, it is *serrate*, and will be coarsely or finely serrate, according to the size of the teeth. Sometimes the edges of large teeth are themselves finely serrated, and in that case the leaf is *doubly serrate* (Fig. 162). If the teeth point *outwards*, that is, if the two edges of each tooth are of the same length, the leaf is *dentate*; but if the teeth, instead of being sharp, are *rounded*, the leaf is *crenate* (Fig. 163). The term *wavy* explains itself.

Fig. 162.

179. **Base.** There are two or three peculiar modifications of the bases of simple sessile leaves which are of considerable importance in distinguishing plants. Sometimes a pair of lobes project backwards and cohere on the other side of the stem, so that the stem appears to pass through the leaf. This is the case in our common Bellwort, the leaves of which are accordingly described as *perfoliate* (Fig. 164). Sometimes two opposite sessile leaves grow together at the base and clasp the stem, as in the upper leaves of Honeysuckle, in the Triosteum, and in one of our species of Eupatorium. Such leaves are said to be *connate* or *connate-perfoliate* (Fig. 165). In one of our Everlastings the margin of the leaf is continued on each side below the point of insertion, and the lobes grow fast to the sides of the stem, giving rise to what is called the *decurrent* form (Fig. 166).

Fig. 163.

Fig. 164.

Figs. 162 to 164.—Various forms of foliage-leaves.

The terms by which simple leaves are described are applicable also to the leaflets of compound leaves, to the sepals and petals of flowers, and, in short, to any flat forms.

Fig. 165.

Fig. 166.

180. We have already explained that compound leaves are of two forms, *pinnate* and *palmate.* In the former the leaflets are arranged on each side of the mid-rib. There may be a leaflet at the end, in which case the leaf is *odd-pinnate;* or the terminal leaflet may be wanting, and then the leaf is

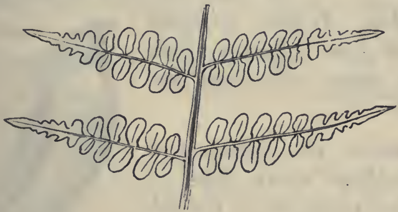


Fig. 167.

abruptly pinnate. In the Pea, the leaf is pinnate and terminates in a *tendril* (Fig. 135). Very frequently the primary divisions of a pinnate leaf are themselves pinnate, and the whole leaf is then *twice-pinnate* (Fig. 167). If

Figs. 165 to 167.—Various forms of foliage-leaves.

the sub-division is continued through another stage, the leaf is *thrice-pinnate*, and so on. Sometimes, as in the leaves of the Tomato, very small leaflets are found between the larger ones, and this form is described as *interruptedly pinnate* (Fig. 168).


Fig. 168.

In the palmate or digitate forms the leaflets spread out from the end of the petiole, and, in describing them, it is usual to mention the number of divisions. If there are three, the leaf is *tri-foliolate* ; if there are five, it is *quinque-foliolate.*

181. In the examination of the Mallow we found a couple of small leaf-like attachments on the petiole of each leaf, just at the junction with the stem. To these the name *stipules* was given. Leaves which have not these appendages are *exstipulate.*


Fig. 169.

182. Besides the characters of leaves mentioned above, there remain a few others to be noticed. With regard to their **surface**, leaves present every gradation from perfect smoothness, as in Wintergreen, to extreme roughness or woolliness, as in the Mullein. If hairs are entirely absent,

Fig. 168.—Interruptedly pinnate leaf.
Fig. 169.—Leaf of Pitcher-Plant.

the leaf is *glabrous*; if present, the degree of hairiness is described by an appropriate adverb; if the leaf is completely covered, it is *villous* or *villose*; and if the hairs are on the margin only, as in our Clintonia, it is *ciliate*. Some leaves, like those of the Cabbage, have a kind of bloom on the surface, which may be rubbed off with the fingers; this condition is described as *glaucous*.

183. A few plants have **anomalous leaves.** Those of the Onion are *filiform*. The Pitcher-Plant of our northern swamps has very curious leaves (Fig. 169), apparently formed by the turning in and cohesion of the outer edges of an ordinary leaf so as to form a tube, closed except at the top, and armed on the inner surface with bristles pointing towards the base of the leaf.

184. Finally, as leaves present an almost infinite variety in their forms, it will often be necessary in describing them to combine the terms explained above. For instance, a leaf may not be exactly linear, nor exactly lance-shaped, but may approximate to both forms. In such a case the leaf is described as *lance-linear*, and so with other forms.

The following form of schedule may be used with advantage in writing out descriptions of leaves. Two leaves — one of Maple and one of Sweet Brier — are described by way of illustration. If a leaf is compound, the particulars as to outline, margin, apex, base, and surface will have reference to the leaflets.

The exercise-book prepared to accompany this work contains a supply of blank schedules for leaf-description, with space for drawings.

LEAF SCHEDULE.

LEAF OF	MAPLE.	SWEET BRIER.
1. Position.	Cauline.	Cauline.
2. Arrangement.	Opposite.	Alternate.
3. Insertion.	Petiolate.	Petiolate.
4. Stipulation.	Exstipulate.	Stipulate.
5. Division.	Simple.	Odd pinnate, 7 leaflets.
6. Venation.	Palmate.	
7. Outline.		Roundish or oval.
8. Margin.	Deeply lobed.	Doubly serrate.
9. Apex.	Pointed.	Acute.
10. Base.	Cordate.	Hardly indented.
11. Surface.	Glabrous above; whitish beneath.	Downy above; covered with glands beneath.

CHAPTER XVIII.

MORPHOLOGY OF FLOWER-LEAVES—INFLORESCENCE—THE CALYX—THE COROLLA—THE STAMENS—THE PISTIL—THE FRUIT—THE SEED—GERMINATION.

185. From an examination of the various forms presented by foliage-leaves, we proceed now to those of the floral ones, and we shall first consider the chief modifications in the *arrangement of flowers as a whole*, to which the term **inflorescence** is applied.

As the organs of which flowers are made up are strictly leaf-forms, the special stalks upon which they are produced (peduncles and pedicels) are true branches, and their development is in strict accordance with the principles enunciated in sections 141–144. As there stated, the almost invariable mode of branching in phanerogams is monopodial, either after the *botryose* type or after the *cymose* type. So inflorescence is found to proceed upon one or other of these two plans.

186. To understand these let us recur to our specimens of Shepherd's Purse and Buttercup. You will remember that in the former the peduncle continues to lengthen as long as the summer lasts, and new flowers continue to be produced at the upper end. Observe, however, that every one of the flowers is produced on the side of the stem, that as the stem lengthens new lateral buds appear, and that *there is no flower on the end of the stem.* The production of the flowering branches (pedicels) and the continuation of the main axis are, in fact, exactly analogous to the growth of the Spruce, as explained in section 142.

You will easily understand, then, that the production of flowers in such a plant is only limited by the close of the season or by the exhaustion of the plant. Such inflorescence is, therefore, called **indefinite**, or **indeterminate**, or **axillary.** It is sometimes also called *centripetal*, because if the flowers happen to be in a close cluster, as are the upper ones in Shepherd's Purse, the order of development is from the outside *towards the centre.*

187. If you now look at your Buttercup you will be at once struck with the difference of plan exhibited. The main axis or stem has *a flower on the end of it*, and its further growth is therefore checked. And so, in like manner, from the top downwards, the growth of the branches is checked by the production of flowers at their extremities. The mode of inflorescence here displayed is **definite**, or **determinate**, or **terminal.** It is also called *centrifugal*, because the development of the flowers is the reverse of that exhibited in the first mode. The upper, or, in the case of close clusters, the *central*, flowers open first.

188. In either mode the flowers are said to be *solitary*, if (1) single flowers are produced in the axils of the ordinary foliage-leaves (botryose), or (2) if a single flower terminates the stem, as in Tulip (terminal).

189. Of **indeterminate** or **botryose inflorescence** there are several varieties. In Shepherd's Purse we have an instance of the *raceme*, which may be described as a cluster in which each flower is supported on a lateral pedicel of its own, usually in the axil of a bract. If the pedicels are absent and the flowers consequently

sessile in the axils, the cluster becomes a *spike*, of which the common Plantain and the Mullein furnish good examples. The *catkins* of the Willow (Figs. 68 and 69) and Birch and the *spadix* of the Indian Turnip (Figs. 96 and 97) are also spikes, the former having scaly bracts and the latter a fleshy axis. If you suppose the

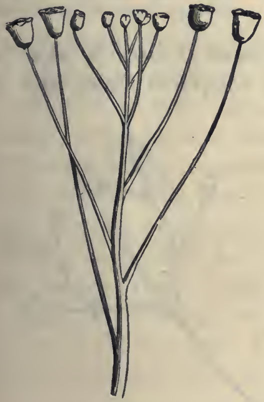


Fig. 170.

Fig. 171.

internodes of a spike to be suppressed so that the flowers are densely crowded, you will have a *head*, of which Clover and Button-bush supply instances. If the lower pedicels of a raceme are considerably longer than the

Fig. 170.—Plan of the simple corymb.
Fig. 171.—Compound raceme. (Gray.)

upper ones, so that all the blossoms are nearly on the same level, the cluster is a *corymb* (Fig. 170). If the flowers in a head were elevated on separate pedicels of the same length, radiating like the ribs of an umbrella, we should have an *umbel*, of which the flowers of Geranium and Parsnip (Fig. 51) are examples. A raceme will be *compound* (Fig. 171) if, instead of a solitary flower, there is a *raceme in each axil*, and a similar remark will apply in the case of the spike, the corymb, and the umbel.

190. The inflorescence of most Grasses is what is called a *panicle.* This is a compound form, and is

Fig. 172.

usually a kind of raceme having its primary divisions branched in some irregular manner.

191. Of **determinate inflorescence** the chief modification is the *cyme.* This is a rather flat-topped

Fig. 172.—A cyme. (Gray.)

cluster, having something the appearance of a compound corymb, but easily distinguished by this peculiarity : that the *central blossom opens first*, then those at the ends of the first set of branches of the cluster, then those on the secondary branches, and so on until the outer buds are reached. The Elder, Dogwood, and St. John's Wort furnish good examples of the cymose structure. Fig. 172 shows a loose, open cyme.

Helicoid and *Scorpioid* cymes have already been described in section 144.

192. Besides the two distinct modes of inflorescence just described, forms are met with which exhibit the peculiarities of both modes. For example, the flower-cluster of the Lilac is botryose or racemose as to the production of its primary branches, but the development of the flowers on the branches is according to the cymose type. On the other hand it sometimes happens, in many of the Composites for example, that the primary branches are cymose while the secondary are botryose. In the Lilac and the Horse-Chestnut the compact mixed cluster is called a *thyrse*. Panicles, also, instead of being altogether botryose, may be of a similar mixed character.

193. In many plants of the Mint Family the flowers appear to form dense whorls at intervals about the stem. Each of these whorls, when analysed, is found to consist of two cymose clusters on opposite sides of the stem. Such whorls are, therefore, mixed, and are often spoken of as *verticillasters*.

194. It has already been pointed out that cauline leaves tend to diminish in size towards the upper part of the stem where the flowers are found. Such reduced

leaves, containing flowers in their axils, are called *bracts.* In the case of compound flower-clusters this term is limited to the leaves on the peduncle or main stem, the term *bractlet* being then applied to those occurring on the pedicels or subordinate stems. In the case of the *umbel* and the *head*, it generally happens that a *circle* of bracts surrounds the base of the cluster. They are then called, collectively, an *involucre*, and in the case of compound clusters a circle of bractlets is called an *involucel.* Bracts are often so minute as to be reduced to mere *scales.* On the other hand they are occasionally very conspicuous and showy, as, for instance, in the four white bracts resembling a flower in the Bunchberry. From our definition it will be evident, also, that the *spathe* surrounding the spadix in Indian Turnip is merely a bract.

195. *Floral symmetry.* Before dealing with the morphology of the separate leaf-forms which go to make up the flower, a few words are necessary in regard to the relations of the different sets of floral organs, both as to number and as to position. The leaves which constitute the flower are arranged about the axis either in whorls, when the flowers are said to be *cyclic;* or in spirals, after the manner of most foliage-leaves, in which case the flowers are *acyclic.* Occasionally the outer sets (the perianth) are in whorls, while the stamens are spirally arranged; then the flowers are said to be *hemicyclic.* The spiral arrangement prevails, as a rule, where the floral organs are very numerous, as, for instance, in the Water Lily and in Buttercup; though Columbine, with very numerous stamens, has cyclic flowers.

196. In cyclic flowers, whilst there is usually one whorl each of sepals, petals, and carpels, there are not unfrequently two whorls of stamens. If each whorl is made up of the same number of members the flower is *isomerous*, and will, at the same time, be *monomerous*, *dimerous*, *trimerous*, *tetramerous*, or *pentamerous*, according as each whorl contains one, two, three, four, or five members. If the numbers of the members in the whorls do not correspond, the flowers are *heteromerous*.

197. The relations of the whorls to each other in any particular case may be very conveniently exhibited by a diagram. Fig. 173, for example, shows the plan of a Lily. The dot at the top of the figure represents the position of the axis of the plant, and should always be shown in a floral diagram. The side of the flower towards the stem is the *posterior* side, the opposite one being *anterior*, and a plane passing through the centre of the flower and also through the stem or axis is called the *median plane*. We have in the flower of the Lily an outer whorl of three members; then alternately with these (and this is the usual plan in cyclic flowers) a second whorl of three members; then the outer whorl of stamens, also three in number; then the three inner stamens; and, finally, the three carpels.

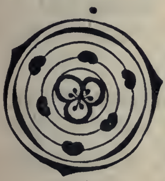


Fig. 173.

198. The composition of this flower may also be expressed by a formula, as follows: K_3, C_3, A_{3+3}, $G^{(3)}$, where K stands for calyx, C for corolla, A for anthers, G for gynœcium. The brackets enclosing the figure

Fig. 173.—Diagram of Lily flower. (Prantl.)

which follows G show the carpels to be united, and the placing of the figure *above* the short line indicates that the ovary is superior; if inferior, the figure would be written below the line. Fig. 174 shows the plan of a Grass-flower. Here parts which are suppressed, and the position of which can in general be easily inferred from that of those which are present, are represented by dots. The formula would be: K_0, C_2, A_{3+0}, $G^{(2)}$.

Fig. 174.

199. The gynœcium is very frequently made up of fewer members (carpels) than the other whorls, and in all such cases the position of the carpels is more or less irregular.

200. Fig. 175 gives the plan of Shepherd's Purse. This shows the four sepals to be in two whorls of two sepals each; the four petals, however, are arranged alternately with the four sepals, as if the latter were all in one whorl; the position of the stamens indicates that the *two* posterior ones, as well as the two anterior ones, occupy the place of single stamens, and have, therefore, probably arisen from the early division of single stamens into pairs. The formula would be: K_{2+2}, C_4, A_{2+2^2}, $G^{(\underline{2})}$; the expression 2^2 indicating the reduplication of the inner stamens.

Fig. 175.

201. If there is no clear distinction between the calyx and corolla, the letter P (for perianth) may be used to include both; and, finally, if the members of any whorl

Fig. 174.—Diagram of a Grass-flower. (Prantl.)
Fig. 175.—Diagram of flower of Shepherd's Purse. (Prantl.)

stand *opposite* those of the one exterior to it, a vertical line may be placed between the symbols, thus: $C_5 \mid A_5$.

202. Other methods of indicating symbolically the relations of the parts of the flower are in vogue; the one just given is recommended by Prantl, and is sufficiently convenient.

203. It has already been mentioned that flowers are said to be irregular when the members of any whorl are of different sizes or shapes, as, for example, in the Pea; and regular, when the opposite is true. Fig. 173 represents one of these regular flowers. A moment's reflection will show that any line whatever drawn across the centre of this diagram will divide it into two exactly similar halves. The term *actinomorphic*, as well as "regular," is applied to all such flowers. Flowers, on the other hand, which can be cut symmetrically in one vertical plane only are *zygomorphic.*

204. In this book, as in most English books, the term "symmetrical" is employed to indicate that the whorls consist of the same number of members each, and it is, in fact, the same in meaning as "isomerous." The later German botanists define a symmetrical flower as "one which can be divided vertically into two halves resembling each other like an object and its reflected image."

We shall now proceed to consider in detail the variations in form assumed by the floral organs individually.

205. **The Calyx.** As you are now well aware, this term is applied to the outer circle of floral leaves. These are usually green, but not necessarily so; in some Exogens, and in nearly all Endogens, they are of some other colour. Each division of a calyx is called a *sepal*, and if the sepals

are entirely distinct from each other, the calyx is *polysepalous;* if they are united in any degree, it is *gamosepalous.* A calyx is *regular* or *irregular* according as the petals are of the same or different shape and size

206. In a gamosepalous calyx, if the sepals are not united to the very top, the free portions are known as *calyx-teeth*, or, taken collectively, as the *limb* of the calyx. The united portion, especially if long, as in Willow-herb, is called the *calyx-tube*, and the entrance to the tube its *throat.* In many plants, particularly those of the Composite Family, the limb of the calyx consists merely of a circle of bristles or soft hairs, and is then described as *pappose.* In other cases the limb is quite inconspicuous, and so is said to be *obsolete.* A calyx which remains after the corolla has disappeared, as in Mallow (Fig. 31), is *persistent.* If it disappears when the flower opens, as in our Bloodroot, it is *caducous;* and if it falls away with the corolla, it is *deciduous.*

We must repeat here, that when calyx and corolla are not both present, the circle which is present is considered to be the calyx, whether green or not.

207. **The Corolla.** The calyx and corolla, taken together, are called the *floral envelopes.* When both envelopes are present, the corolla is the inner one; it is usually, though not invariably, of some other colour than green. Each division of a corolla is called a *petal*, and the corolla is *polypetalous* when the petals are completely disconnected; but *gamopetalous* if they are united in any degree, however slight. The terms *regular* and *irregular*, applied to the calyx, are applicable also to the corolla, and the terms used in the description of leaves are applicable

to petals. If, however, a petal is narrowed into a long and slender portion towards the base, that portion is known

Fig. 176.

as the *claw*, whilst the broader upper part is called the *limb* (Fig. 176). The leaf-terms are then applicable to the limb.

208. Gamopetalous corollas assume various forms, most of which are described by terms easily understood. The forms assumed depend almost entirely on the shape of the petals which, when united, make up the corolla. If these, taken separately, are linear, and are united to the top, or nearly so, the corolla will be tubular (Fig. 177). If the petals are wedge-shaped, they will, by their union, produce a *funnel-shaped* corolla (Fig. 178). In the *campanulate* or *bell-shaped* form, the enlargement from base to summit is more gradual. If the petals are narrowed abruptly into long claws, the union of the claws into a tube and the spreading of the limb at right angles to the tube will produce the *salver-shaped* form, as in Phlox (Fig. 179). The *rotate* corolla differs from this in having a *very short* tube. The corolla of the Potato is rotate.

Fig. 177.

Fig. 178.

209. The most important *irregular* gamopetalous corollas are the *ligulate*, which has been fully described in the examination of the Dandelion, and the *labiate*, of which we found an example in Catnip (Fig. 59). The corolla of Turtle-head (Fig. 180) is another

Fig. 176.—Single petal of a Pink. Fig. 177.—Tubular corolla of a Honeysuckle.
Fig. 178.—Funnel-shaped corolla of Calystegia.

example. When a labiate corolla presents a wide opening between the upper and lower lips, it is said to be *ringent;* if the opening is closed by an upward projection of the lower lip, as in Toadflax (Fig. 181), it is said to be *personate*, and the projection in this case is known as the *palate.* A good many corollas, such as those of Toadflax, Dicentra, Snapdragon, Columbine, and Violet, have protuberances or *spurs* at the base. In Violet one petal only is spurred; in Columbine the whole five are so.


Fig. 179.


Fig. 180.


Fig. 181.

210. *Æstivation.* This is the term applied to the mode in which the sepals and petals are folded in the bud. In general, the members of a calyx or of a corolla overlap in the bud, or they do not. If they stand edge to edge, as in the calyx of Mallow, the æstivation is *valvate.* If there is overlapping, and one or more of the members have *both* edges covered, the æstivation is *imbricate;* and if each member has one edge covered and the other uncovered, as in the corolla of Mallow, Evening Primrose, Phlox, &c., it is then said to be *convolute.* Gamopetalous corollas are frequently *plaited* in the bud, and the plaits may be convolute, as in Morning Glory.

Fig. 179.—Salver-shaped corolla of Phlox.
Fig. 180.—Labiate corolla of Turtle-head.
Fig. 181.—Personate corolla of Toadflax.

211. **The Stamens.** As calyx and corolla are called collectively the floral envelopes, so stamens and pistil are spoken of collectively as the *essential organs* of the flower. The circle of stamens alone is sometimes called the *andrœcium.* A complete stamen consists of a slender stalk known as the *filament*, and one or more small sacs called collectively the *anther.* The filament, however, is not uncommonly absent, in which case the anther is *sessile.* As a general thing, the anther consists of two oblong cells with a sort of rib between them called the *connective*, and that side of the anther which presents a distinctly *grooved* appearance is the *face*, the opposite side being the *back.*


Fig. 182.


Fig. 183.

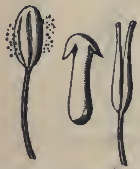

Fig. 184.

The filament is invariably attached to the connective, and may adhere through the entire length of the latter, in which case the anther is *adnate* (Fig. 182); or the base of the connective may rest on the end of the filament, a condition described as *innate* (Fig. 183); or the extremity of the filament may be attached to the middle of the back of the connective, so that the anther swings about: it is then said to be *versatile* (Fig. 184). In all these cases, if the face of the anther is turned towards the centre of the flower, it is said to be *introrse;* if turned outwards, *extrorse.*

Figs. 182, 183, 184.—Stamens showing adnate, innate, and versatile attachments of the anther.

The cells of anthers commonly open along their outer edges to discharge their pollen (Fig. 185). In most of the Heaths, however, the pollen is discharged through a minute aperture at the top of each cell (Fig. 186), and in our Blue Cohosh each cell is provided with a lid or valve near the top, which opens on a kind of hinge (Fig. 187). Occasionally, examples of barren or abortive stamens are met with, as the fifth stamen in Turtle Head and Pentstemon. These are filaments without anthers, and are known as *staminodes.*

212. Stamens may be either entirely distinct from each other—in which case they are described as *diandrous, pentandrous, octandrous,* &c., according to their number (or, if more than twenty, as indefinite)—or they may be united in various ways. If their anthers are united in a circle, while the filaments are separate (Fig. 57), they are said to be *syngenesious;* but if the filaments unite to form a tube, while the anthers remain distinct, they are said to be *monadelphous* (Fig. 32); if they are in two groups they are *diadelphous* (Fig. 37); if in three, *triadelphous;* if in more than three, *polyadelphous.*



Figs. 185. 187. 186.

213. As to **insertion**, when stamens are inserted on the receptacle they are *hypogynous;* when borne on the calyx, *perigynous;* when borne on the ovary, *epigynous;* and if inserted on the corolla, *epipetalous.* They may, however, be borne even on the style, as in Orchis, and then they are described as *gynandrous.*

214. If the stamens are four in number, and in two

Figs. 185, 186, 187.—Anthers exhibiting different modes of dehiscence.

pairs of different lengths, they are said to be *didynamous* (Fig. 60); if six in number, four long and two short, they are *tetradynamous* (Fig. 28); and, finally, if the stamens are hidden in the tube of a gamopetalous corolla they are said to be *included*, but if they protrude beyond the tube they are *exserted* (Fig. 177).

215. **The Pistil.** This is the name given to the central organ of the flower. It is sometimes also called the *gynœcium.* As in the case of the stamens, the structure of the pistil must be regarded as a modification of the structure of leaves generally. The pistil may be formed by the folding of a single carpellary leaf, as in the Bean (Fig. 188), in which case it is *simple;* or it may consist of a number of carpels, either entirely separate from each other or united together in various ways, in which case it is *compound.* By some botanists, however, the term compound is restricted to the case of united carpels. If the carpels are entirely distinct, as in Buttercup, the pistil is *apocarpous;* if they are united in any degree, it is *syncarpous.* A pistil of one carpel is *monocarpellary;* of two, *dicarpellary;* and so on, to *polycarpellary.*

Fig. 188.

216. The terms *inferior* and *superior*, as applied to the pistil, describe its situation upon the axis relative to that of the calyx, corolla, and stamens. It will be remembered that the end of the peduncle is usually enlarged, forming what is called the *torus* or receptacle. Usually the receptacle is a little higher in the centre

Fig. 188.—Legume of the Bean.

than at its margin, and as the gynœcium occupies this central part, its position is above that of the other floral leaves, as shown in Fig. 189. Here the pistil is *superior*, and the stamens and petals hypogynous. But frequently the outer part of the receptacle grows more vigorously than the centre, forming, in fact, a cup with the pistil in the bottom of it, and the stamens and petals around

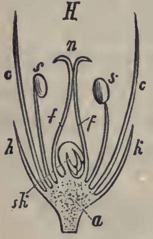


Fig. 189.

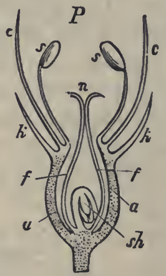


Fig. 190.

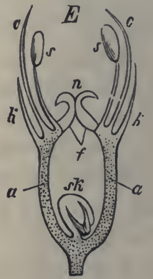


Fig. 191.

its margin (Fig. 190). In this case the pistil may be described as half-inferior, and the stamens and petals as perigynous. Often the cup-shaped receptacle grows fast to the ovary all round. In other cases, the carpels, instead of being developed from the bottom of the cup, spring from the margin, thus forming a roof-like disk, around the edge of which the stamens are attached (Fig. 191). Here the stamens are epigynous, and the ovary is truly *inferior*. Other cases of epigyny and perigyny arise from the adnation (growing together) of the floral whorls without exceptional development of the

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Figs. 189, 190, 191.—Diagrams illustrating hypogynous (*H*), perigynous (*P*), and epigynous (*E*) flowers; *a*, axis; *k*, calyx; *c*, corolla; *s*, stamens; *f*, carpels; *n*, stigma; *sk*, ovule. (Prantl.)

receptacle. The cases of the Rose, Cherry, and Apple have already been referred to (Chapter VI.).

217. In our examination of the Marsh Marigold (Figs. 24 and 25) we found an apocarpous pistil of several carpels. We found also that each carpel contained a number of seeds, and that in every case the seeds were attached to that edge of the carpel *which was turned towards the centre of the flower*, and that, as the carpels ripened, they invariably split open along that edge, but not along the other, so that the carpel when opened out presented the appearance of a leaf with seeds *attached to the margins.* The inner edge of a simple carpel, to which the seeds are thus attached, is called the *ventral suture*, the opposite edge, corresponding to the mid-rib of a leaf, being the *dorsal suture.*

218. If we suppose a number of simple carpels to approach each other and unite in the centre of a flower, it is evident that the pistil so formed would contain as many cells as there were carpels, the cells being separated from each other by a *double wall*, and that the seeds would be found arranged about the centre or axis of the pistil; and this is the actual state of things in the Tulip, whose pistil is formed by the union of three carpels. When the pistil ripens, the double walls separating the cells split asunder. To these separating walls the name *dissepiment* or *partition* is given.

219. The cells are technically known as *loculi.* An ovary with one cell is *unilocular;* with two, *bilocular;* with several, *multilocular.* Between the unilocular and multilocular forms there are all shades of gradation. In some cases, as, for example, in Saxifrage, the carpels

are united below but separate above. Sometimes, also, false partitions are formed across the loculi in the course of growth. In the Mints, for instance, there are at first but two loculi; eventually, however, there are four, which completely separate at the time of ripening.

220. But it often happens that though several carpels unite to form a compound pistil, there is but *one cell* in the ovary. This is because the separate carpellary leaves have not been folded before uniting, but have been joined edge to edge, or rather with their edges slightly turned inwards. In these cases the seeds cannot, of course, be in the centre of the ovary, but will be found *on the walls*, at the junction of the carpels (Figs. 192 and 193). In some plants the ovary is one-celled, and the seeds are arranged round a column which rises from the bottom of the cell (Figs. 194 and 195). This case is explained by the early obliteration of the partitions, which must at first have met in the centre of the cell. Special cases, however, are found in which no trace of partitions has been observed, and these must consequently be explained by the actual upward growth of the axis into the centre of the ovary.

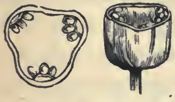

Fig. 193. Fig. 192.

Fig. 194. Fig. 195.

221. In all cases the line or projection to which the seeds are attached is called the *placenta*, and the term **placentation** has reference to the manner in which the placentas are arranged. In the simple pistil the placentation is *marginal* or *sutural*. In the syncarpous

Figs. 192, 193.—Compound one-celled ovary of Mignonette.

Figs. 194, 195.—Sections of ovary of a Pink, showing free central placentation.

pistil, if the dissepiments meet in the centre of the ovary, thus dividing it into separate cells, the placentation is *central* or *axile;* if the ovary is one-celled and bears the seeds on its walls, the placentation is *parietal;* and if the seeds are attached to a central column it is *free central.*

222. Besides the union of the ovaries there may also be a union of the styles, and even of the stigmas.

223. A very exceptional pistil is found in plants of the Pine Family. Here the ovules, instead of being enclosed in an ovary, are usually simply attached to the inner surface of an open carpellary leaf or scale, the scales forming what is known as a *cone* (Figs. 196, 197, and 198). The plants of this family are hence called *gymnospermous*, or naked-seeded.

Fig. 196.

Figs. 197, 198.

224. **Nectaries.** This name is given to that part of a flower which has been specially formed for the secretion of honey. The nectaries need not, however, be looked upon as separate or independent organs. Sometimes they are to be found at the base of the petals, as in Buttercup; sometimes at the base of the stamens, as in the Grape. Very commonly they are at the bottom of deep spurs formed on one or more divisions of the perianth, as in Violet, many Orchids, and in Columbine.

225. **Phyllome** and **Trichome.** To all leaf-forms, whether ordinary foliage-leaves or those special modifications which make up the flower—sepals, petals, stamens,

Fig. 196.—A cone.
Fig. 197.—Single scale showing position of the two seeds on the inner face.
Fig. 198.—One of the winged seeds removed.

and carpels—the general term *phyllome* is applicable. The characteristic of the phyllome is that it is a lateral outgrowth of the stem or its branches.

226. The term *trichome*, on the other hand, is applicable to any hair-like appendage on the surface of the plant generally, whether of root, stem, or leaf. The commonest form of trichome is the *hair*. The root-hairs which generally clothe the surface of young roots are of great importance as absorbing agents. Each root-hair consists of a single, delicate, tube-like cell with extremely thin walls. Other hairs may consist of several such cells placed end to end. Others, again, may branch extensively. It sometimes happens that the terminal cell of a hair produces a gummy substance which comes away with the slightest touch. The sticky surfaces of many common plants are due to the presence of such hairs, which are then described as *glandular*. Gummy matters are also secreted by *glands* close to the surface of the plant. *Peltate* hairs are occasionally met with, as in the leaves of Shepherdia. They give a scurfy appearance to the surface upon which they grow. Then there are hairs which secrete *odorous* fluids, as, for example, those upon the surface of the Sweet Brier. These probably serve to attract insects. *Stinging* hairs are also common. They contain an irritating fluid. When the point of the hair pierces the skin it is broken off, and the fluid then escapes into the wound.

227. Besides the trichome forms just mentioned, there are also *bristles*, formed from hairs by the gradual thickening and hardening of their walls, and *prickles*, such as those of Sweet Brier (Fig. 199), which consist of many

hard-walled woody cells closely packed together. That prickles are really trichomes is shown by the fact that when the bark is stripped off they come away along with it. *Spines*, on the other hand (Fig. 200), are lateral outgrowths of the stem. They are, in fact, generally stunted branches, and will be found to spring originally from the axils of leaves. Occasionally the petiole of a leaf is converted into a spine, which then becomes a true phyllome. Ovules are generally regarded as trichomes since they arise from the inner surface of the carpels.

Fig. 199.

Fig. 200.

228. **The Fruit.** In coming to the consideration of the fruit, you must for the present lay aside any popular ideas you may have acquired as to the meaning of this term. You will find that, in a strict botanical sense, many things are fruits which, in the language of common life, are not so designated. For instance, we hardly speak of a pumpkin or a cucumber as fruit, and yet they are clearly so, according to the botanist's definition of that term. A fruit may be defined to be *the ripened pistil together with any other organ, such as the calyx or receptacle, which may be adherent to it.* This definition will, perhaps, be more clearly understood after a few specimens have been attentively examined.

229. For an example of the simplest kind of fruit let

Fig. 199.—Prickles of Sweet Brier. Fig. 200.—Spines of the Hawthorn.

us revert to our Buttercup. As the carpels ripen, the style and stigma are reduced to a mere point. On cutting open one of these carpels when fully ripe, we find it contains a single seed, not quite filling the cavity, but attached at one point to the wall of the latter. What you have to guard against, in this instance, is the mistake of considering the entire carpel to be merely a seed. It is a seed enveloped in an outer covering which we called the ovary in the early stages of the flower, but which, now that it is ripe, we shall call the *pericarp*. This pericarp, with the seed which it contains, is the fruit. The principal difference between the fruit of Marsh Marigold and that of Buttercup is that, in the former, the pericarp envelopes several seeds, and, when ripe, *splits open down one side*. The fruit of Buttercup does not thus split open. In the Pea, again, the pericarp encloses several seeds, but splits open along *both* margins. The fruits just mentioned all result from the ripening of *apocarpous* pistils, and they are consequently spoken of as *apocarpous fruits*.

230. In Willow-herb, you will recollect that the calyx-tube adheres to the whole surface of the ovary. The fruit in this case, then, must include the calyx. When the ovary ripens, it splits longitudinally into four pieces (Fig. 41), and, as the pistil was *syncarpous*, so also is the fruit.

231. In the Peach, Plum, Cherry, and *stone-fruits* or *drupes* generally, the seed is enclosed in a hard shell called a *putamen*. Outside the putamen is a thick layer of pulp, and outside this, enclosing the whole, is a skin-like covering. In these fruits all outside the seeds is the pericarp. In one respect these stone-fruits resemble the

fruit of the Buttercup: they do not split open in order to discharge their seeds. All fruits having this peculiarity are said to be **indehiscent,** whilst those in which the pericarp opens, or separates into pieces, are **dehiscent.**

232. In the Apple (Fig. 50) and Pear, the seeds are contained in five cells in the middle of the fruit, and these cells are surrounded by a firm fleshy mass, which is mainly an enlargement of the calyx. In fact, the remains of the five calyx-teeth may be readily detected at the end of the apple opposite the stem. As in Willow-herb, the calyx is adherent to the ovary, and therefore calyx and ovary together constitute the pericarp. These *fleshy fruits*, or *pomes*, as they are sometimes called, are of course *indehiscent.*

233. In the Currant, as in the Apple, you will find the remains of a calyx at the top, so that this fruit, too, is *inferior*, but the seeds, instead of being separated from the mass of the fruit by tough cartilaginous cell-walls, as in the Apple, lie imbedded in the soft, juicy pulp. Such a fruit as this is a *berry.* The Gooseberry and the Grape are other examples. The Pumpkin and other *gourds* are similar in structure to the berry; but, besides the soft inner pulp, they have also a firm outer layer and a hard rind. The name *pepo* is generally given to fruits of this sort.

Fig. 201.

234. A Raspberry or Blackberry (Fig. 201) proves, on examination, to be made up of a large number of juicy little drupes, aggregated upon a central axis. It cannot, therefore, be a true berry, but may be called an *aggregated* fruit.

Fig. 201.—Aggregated fruit of the Raspberry.

235. A strawberry (Fig. 202) is a fruit consisting chiefly of a mass of pulp, having its surface dotted all over with little carpels (achenes), similar to those of the Buttercup. The flesh of the Strawberry is simply an enlarged *receptacle ;* so that this fruit, also, is not a true berry.


Fig. 202.

236. The fruit of Sweet Brier (Fig. 45) consists of a red fleshy calyx, lined with a hollow receptacle which bears a number of achenes. This fruit is, therefore, analogous to that of the Strawberry. In the latter the achenes are on the outer surface of a *raised* receptacle, while in the former they are on the inner surface of a *hollow* receptacle.

When other parts of the flower are combined with the ovary in fruit, as in Apple, Rose, and Strawberry, the result is sometimes described as a *pseudocarp*, or spurious fruit.

237. The cone of the Pine (Fig. 116) is a fruit which differs in an important respect from all those yet mentioned, inasmuch as it is the product, not of a single flower, but of as many flowers as there are scales. It may, therefore, be called a *collective* or *multiple* fruit. The Pine Apple is another instance of the same thing.

238. Of dehiscent fruits there are some varieties which receive special names. The fruit of the Pea or Bean (Fig. 188), whose pericarp splits open along *both* margins, is called a *legume ;* that of Marsh Marigold (Fig. 25), which opens down one side only, is a *follicle.* Both of these are apocarpous.

Fig. 202.—Section of a Strawberry.

239. Any syncarpous fruit having a dry *dehiscent* pericarp is called a *capsule.* The dehiscence of syncarpous or polycarpellary fruits is of several kinds. If the rupture takes place along the partitions the fruit will be split up into its original carpels; this form of dehiscence is *septicidal* (Fig. 203). But the dehiscence may take place along the dorsal suture of each carpel, half-way between the partitions, so that the opening is into the loculus; this mode is known as *loculicidal* (Fig. 204). Or again, the valves (separate pieces of the pericarp) may fall away, leaving the partitions standing; this dehiscence is *septifragal* (Fig. 205).

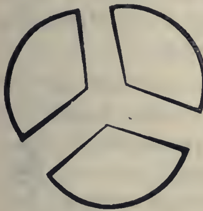

Fig. 203.

Fig. 204.

240. A long and slender capsule, having two cells separated by a membranous partition bearing the seed, and from which, when ripe, the valves fall away on each side, is called a *silique* (Fig. 206). If, as in Shepherd's Purse (Fig. 29), the capsule is short and broad, it is called a *silicle.* If the capsule opens *horizontally*, so that the top comes off like a lid, as in Purslane (Fig. 207), it is a *pyxis.*

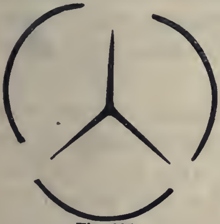

Fig. 205.

241. Any dry, one-seeded, *indehiscent* fruit is called an *achene*, of which the fruit of Buttercup (Fig. 14) is an

Figs. 203, 204, 205.—Diagrams illustrating septicidal, loculicidal, and septifragal dehiscence.

example. In Wheat the fruit differs from that of Buttercup in having a closely fitting and *adherent* pericarp. Such a fruit is called a *caryopsis* or *grain*. A *nut* is usually syncarpous, with a hard, dry pericarp. A *winged* fruit, such as that of the Maple (Fig. 208), is called a *samara* or *key*.

Fig. 206.

242. A fruit which splits up when ripe into several one-seeded pieces is called a *schizocarp*. The samara of the Maple is a good example; also the fruit of Catnip, which splits up at maturity into four one-seeded portions. The fruit of Mallow is another common instance. The separate portions in these cases are called *mericarps*. In some leguminous plants the pod breaks up *transversely* into one-seeded portions, giving rise to the form called a *loment*.

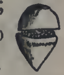

Fig. 207.

Fig. 208.

243. A special schizocarp is that of Umbelliferous plants (Fig. 209). Here the fruit splits into two mericarps, each attached, however, by a fibre to the axis. Such a fruit is called a *cremocarp*.

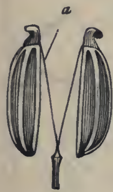

Fig. 209.

244. **The Seed.** The seed has already been described as the *fertilized ovule*. During the formation of the carpels, the ovules arise as outgrowths from the inner surface of the ovary, mostly, as has been pointed out, upon the *margins* of the carpellary leaves, but occasionally also upon the surface generally. At first the ovule

Fig. 206.—Silicle of Stock. Fig. 207.—Pyxis of Purslane.
Fig. 208.—Samara of Maple.
Fig. 209.—Cremocarp of an Umbellifer; *a*, the fibre attaching the mericarp to the axis. (Thomé.)

is a simple, soft mass with no indication whatever of the covering so manifest in ripe seeds of all kinds. Very soon, however, after the appearance of the body of the ovule, a circular ridge is developed upon it, and this gradually extends upwards over the surface so as to form a coat, which at length entirely covers it except at the very apex, where a minute opening is left. Very commonly, but not always, a second coat is developed exactly in the same manner, outside the first, and an opening is left in this coat also, precisely over the other. This minute passage through both coats to the ovule body has already been named the *micropyle.* The two coats are known as the *primine* (generally, though not always, applied to the outer) and the *secundine*, and the central body is the *nucleus.*

245. If the ovule appears to arise directly from the placenta without the intervention of a stalk, it is *sessile;* but if a stalk is present, this is known as the *funiculus.* In the accompanying diagram (Fig. 210) which represents a section of the complete ovule, *k* is the nucleus; *ai*, the primine; *ii*, the secundine; *m*, the micropyle; *f*, the funiculus. The point *(c)* where the two coats and the nucleus are blended together is called the *chalaza.* The portion of the nucleus marked *em* is the cavity called the embryo-sac, already referred to in Chapter II.

246. It must now be pointed out that though the ovules at the commencement of their growth are straight, as in the diagram just described, yet they do not commonly remain so. Very often the ovule bends over so as to appear completely inverted, in which case the funiculus grows fast to one side of the primine, becoming completely fused

with it, and forming what is then called the *raphe*. Fig. 211 represents this condition, *r* being the raphe, *s* the chalaza, and the other letters corresponding to those in Fig. 210.

Sometimes the curving of the ovule upon itself is not carried to this extreme, and an intermediate form is presented, as in Fig. 212.

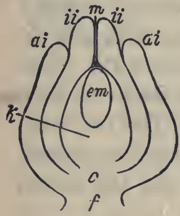

Fig. 210.

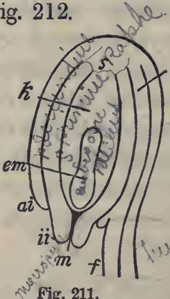

Fig. 211.

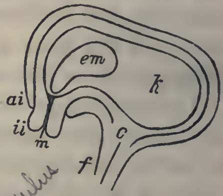

Fig. 212.

If the ovule remains straight it is said to be *orthotropous;* if completely inverted, *anatropous;* if half bent over, *campylotropous.*

247. **Pollination.** The process of fertilization, by which the ovule is converted into the seed, has been briefly described in Chapter II. A few words may be added here upon *pollination*—the process of supplying pollen to the stigma. In very many flowers which have both stamens and pistil (and hence called *hermaphrodite*), the process is very simple. Either the anthers and stigma are so close together that the pollen cannot fail to be deposited upon the stigma immediately upon the opening of the anther, or the stigma is upon a lower level, so that the pollen drops upon it, or, in special cases, as in

Figs. 210, 211, 212.—Diagrams of orthotropous, anatropous, and campylotropous ovules, (Prantl.)

Impatiens and Wood Sorrel, besides the ordinary large flowers, there are special small ones (known as *cleistogamous* flowers) whose floral envelopes do not open, thus *compelling* self-fertilization. But it is well established that in a vast number of cases the ovules in any given flower have to depend for fertilization upon the pollen of some other flower. Nature seems to have provided against self-fertilization by various contrivances. Sometimes the relative positions of the anthers and the stigma in the same flower are such as to render it impossible. Sometimes the pollen comes to maturity and is shed from the anthers before the stigma is in a suitable condition to receive it; whilst, on the other hand, the stigma is often developed first and has withered before the opening of the anthers. (Flowers showing these peculiarities are said to be *dichogamous*.) When for any reason cross-fertilization has become a necessity, the conveyance of the pollen from one flower to another is ensured in various ways. When the flowers are inconspicuous, as in Grasses, the wind is the great agent, and flowers so fertilized are said to be *anemophilous*. In other cases the flowers, either by their brightness or their odour, attract insects in quest of honey, and these then become the carriers of the pollen. Flowers of this sort are said to be *entomophilous*, and are usually so constructed as to the situation of their honey receptacles, and the relative position of anthers and stigma, as to ensure the transfer of the pollen from the anther of one flower to its destination upon the stigma of another. The case of the Orchids has already been referred to in section 92.

248. After fertilization, the embryo, or young plantlet, as exhibited in the seed, begins its growth in that end of

the embryo-sac which is next the micropyle, and about the same time, in the other end of the embryo-sac, there begins a deposit of matter intended for the nourishment of the embryo during the germination of the seed. This deposit has been already referred to under the name of *albumen.* It is also known as *endosperm.* As the embryo developes, this endosperm or albumen may be completely absorbed by it, so that at maturity the embryo will occupy the whole space within the seed-coats, as in the Bean. In this case the seed is *exalbuminous.* In other cases, as in Indian Corn, the endosperm remains as a distinct mass with the embryo embedded in it, or sometimes wrapped round it. Seeds of this kind are *albuminous.* Rarely this nourishing material is deposited outside the embryo-sac, in the body of the ovule. It is then known as *perisperm.*

249. The ripened seed presents very different aspects in different plants. It may be resolved, however, into the *nucleus* and the *integument* (the *spermoderm* of some botanists). The former is made up of the embryo, together with the endosperm or perisperm, if present, while the latter consists of two layers: an outer, known as the *testa*, and an inner, the *tegmen.* The scar showing where the seed has been attached to the placenta is called the *hilum ;* it is very distinct in the Bean.

250. Besides the integument just mentioned, occasionally an additional outer coat is formed, to which the term *aril* is applied. The fleshy red covering of the seed in our Ground Hemlock is a good example.

251. The seeds of Willow-herb, Milkweed, and many other plants are furnished with tufts of hair-like bristles

which facilitate their dispersion by the wind. These tufts grow from the testa of the seed, and are not to be confounded with the pappus of the Thistle, Dandelion, &c.; the latter, it will be remembered, is an outgrowth of the calyx.

252. The embryo, as already explained, generally consists of an axis or stem called the *radicle* (or, more properly, the *caulicle*, because it is in all respects a true stem and not a root), and one or more leaves called *cotyledons*, with sometimes, also, a bud known as the *plumule*. As to the number of cotyledons, it may be repeated here that seeds are, as a rule, either dicotyledonous or monocotyledonous. Some plants of the Pine Family, however, have six cotyledons, whilst, on the other hand, in the Orchids and a few other plants, these organs are altogether wanting.

253. The cotyledons vary greatly in thickness. In the Maple, for example, they are very thin, while in the Pea, the Bean, and the Oak they are extremely thick and fleshy.

254. **Germination.** If a seed is supplied with proper warmth and moisture it soon begins to swell and soften by absorption of water, with the effect of bursting the seed-coats to a greater or less degree. At the same time the process of *growth* is begun. This early growth of the embryo is *germination*. The details of the process vary somewhat according to the structure of the seed. In dicotyledons, if the seed-leaves are thin and leaf-like, containing within themselves but scanty store of nourishment, the radicle will grow throughout its length so as to raise the cotyledons above the soil, where they at once

expand and become the earliest leaves of the new plant; and during this upward extension of the radicle a root also is being rapidly developed from its lower end. It is important, also, to notice here that the mode of growth of the root portion is at variance with that of the radicle or stem proper, for while the latter grows *throughout its length*, the former grows by the addition of successive new portions *to its extremity.* (The protection of the growing root by a *root-cap* has already been referred to.) As soon as the root is prepared to absorb nourishment from the soil, then, and not till then, the development of the next bit of stem commences between the first pair of leaves.

255. But when the cotyledons are loaded with nourishment, as in the Bean, it will generally be found that the elements of additional bits of stem (the plumule) are already present in the embryo, and although the radicle may lengthen so as to lift the cotyledons above the surface, yet these do not, as in the thin-leaved embryos, fully perform the office of foliage-leaves; their true function is to supply the newly developing parts with nourishment, and when this duty is performed they usually drop off. In fact, it is not uncommon for such extremely fleshy cotyledons to remain under the surface altogether, as in the case of the Pea and the Acorn. In these cases the growth of the radicle is but slight. The plumule and the end of the radicle are liberated from the seed, and the former at once grows vigorously upward, being practically independent of the root as long as the stock of nourishment in the cotyledons holds out. Simultaneously with the development of the stem, the root is strongly developed from the end of the short radicle.

256. In the monocotyledons the process of germination is much the same as that just described, with the important difference, however, that the primary root from the end of the radicle can scarcely be said to develope at all, a cluster of fibrous roots bursting out almost at once from its sides. Indian Corn answers very well as an illustration. Here the seed, largely made up of endosperm or albumen, remains in the ground. The single cotyledon is wrapped round the plumule and adheres by its back to the endosperm, acting thus as a medium through which nourishment is absorbed, and of course not being carried up to the surface. The plumule is rapidly carried upward, developing alternate leaves, and the numerous fibrous roots are given off from the sides of the short radicle.

257. The young student is strongly recommended to investigate for himself the phenomena of germination as exhibited in common seeds. For this purpose he may place a few Windsor beans and grains of Indian Corn between layers of moist flannel or coarse paper in a shallow dish. If kept damp, germination will begin in a day or two, and if sufficient specimens have been provided the process may be observed at various stages. Trial should also be made of the length of time during which seeds will retain their vitality. Many seeds, such as those of Elm and Poplar, will be found to germinate only if they have been kept fresh and not permitted to dry up, whilst others, such as Indian Corn and Wheat, and in general those containing starch, may be kept for a very long time without losing their germinating power.

CHAPTER XIX.

ON THE MINUTE STRUCTURE OF PLANTS — THE CELL — TISSUES—TISSUE-SYSTEMS—EXOGENOUS AND ENDOGENOUS STEMS.

258. Up to this point we have been engaged in observing such particulars of structure in plants as are manifest to the naked eye. It is now time to enquire a little more closely, and find out what we can about the *elementary* structure of the different organs. We have all observed how tender and delicate is a little plantlet of any kind just sprouting from the seed; but as time elapses, and the plant developes itself and acquires strength, its substance will, as we know, assume a texture varying with the nature of the plant, either becoming hard and firm and woody, if it is to be a tree or a shrub, or continuing to be soft and compressible as long as it lives, if it is to be an herb. Then, as a rule, the leaves of plants are of quite a different consistency from the stems, and the ribs and veins and petioles of foliage-leaves are of a firmer texture than the remaining part of them. In all plants, also, the newest portions, both of stem and root, are extremely soft compared with the older parts. It will be our object in this chapter to ascertain, as far as we can, the reason of such differences as these; and to accomplish this we shall have to call in the aid of a microscope of much higher power than that which has hitherto served our purpose.

259. First let us examine under our microscope a very thin slice of the pith of the Elder. You see at once that

the whole slice is made up of more or less rounded, nearly transparent bodies, rather loosely thrown together, as shown in Fig. 213. Next let us examine, in the same way, a thin slice of the tuber of the Potato. Here,

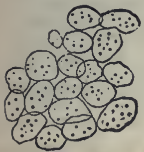

Fig. 213.

again, it is evident that the object under examination is wholly composed of enclosed spaces, not so much rounded, however, as those of the Elder pith, because they are more closely packed together. Fig. 214 is a representation of two of these spaces. Now look at the leaf of a Moss, and you see again that we have an aggregation of enclosed spaces as before (Fig. 215). So, also, if we examine a hair from the surface of a Petunia or a Geranium, we have some such appearance presented to us as that shown in Figs. 216 and 217, the hairs manifestly consisting of several enclosed spaces placed end to end. In short, the microscope reveals to us the fact that every part of a plant is made up of such enclosed spaces, varying greatly in shape and size and general aspect, it is true, but always (except in some of the very lowest plants) clearly exhibiting boundaries; and since these boundaries are visible, no matter in what direction we make our cutting, it is clear

Fig. 214.

that the spaces must be shut in on all sides. These enclosed spaces are called *cells*, and their boundaries are known as the *cell-walls*.

Fig. 213.—Loosely-packed cells of Elder-pith.

Fig. 214.—Two cells of Potato tuber containing starch-granules and crystalloids. (Gray.)

260. Whilst looking at the parts of plants just submitted to examination, it must have struck you that the interior of the cell presents a very different appearance in different cases. The Potato section, for example, is not at all like the Moss-leaf section in the matter of *cell-contents*, and the cells of the Elder-pith appear to be quite empty. We shall discuss these differences presently. In the meantime let us study the appearance of some cells taken fresh from some part of a plant where growth is actually going on—say the point of a new rootlet. If our section is taken near enough to the point we shall get cells which have just been formed. Such a section is very well shown in Fig. 218. Here the cells are seen to be completely filled with liquid having a

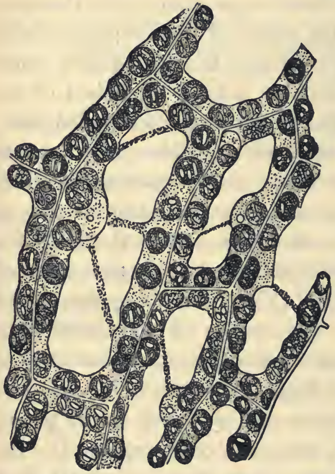

Fig. 215.

Fig 216.

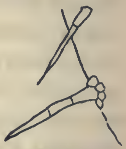

Fig. 217.

Fig. 215.—Cells from leaf of a Moss containing protoplasm and chlorophyll-granules.

Fig. 216.—Hair from Petunia leaf. Fig. 217.—Hairs from Geranium leaf.

granular appearance, and in the centre of each a rounded denser portion may be made out, each of these again enclosing one or more smaller bodies. This liquid which thus fills the newly-formed cells is called *protoplasm;* the large rounded central mass is the *nucleus*, consisting of denser protoplasm, and the smaller enclosed masses are the *nucleoli.*

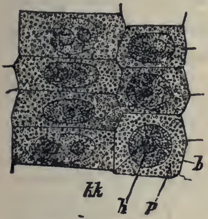

Fig. 218.

Now let us consider Fig. 219. This is a representation of a section of the same rootlet, taken a little farther back from the point, so that the cells now in view are a little older than the first ones. They are manifestly larger; that is to say, they have *grown.* The nucleus and the nucleoli can still be made out in some of them, but the protoplasm no longer entirely fills the cell. There are now transparent spaces (*vacuoles*) which are filled with water, and between these the protoplasm is seen in the form of strings or bands, as well as lining the cell.

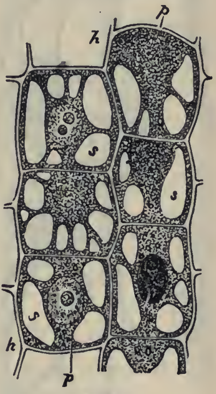

Fig. 219.

The water has been absorbed through the cell-wall, and after saturating the protoplasm the excess has formed the vacuoles.

Fig. 218.—Young cells filled with protoplasm (*p*); *b*, cell wall; *h*, nucleus; *kk*, nucleolus. (Sachs.)

Fig. 219.—Cells a little older, exhibiting vacuoles (*s*). (Sachs.)

Fig. 220 shows some cells from the same rootlet taken still farther back. It is clear that the change observed in Fig. 219 has been carried to a still greater extent. In some of these cells the protoplasm is restricted to the lining of the cell and the nucleus.

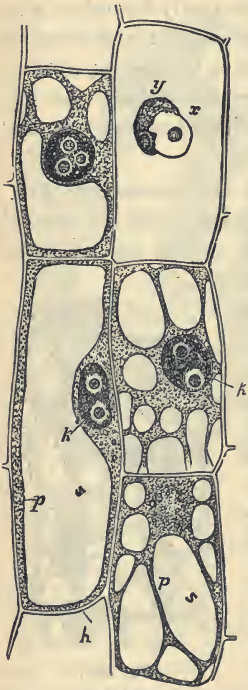

Fig. 220.

261. It is now to be observed that the protoplasm is the essential part of every living cell. Through its agency all the vital processes of the plant are carried on. Every cell of every plant at some time or other contains this substance, and when at length it disappears the cells which are deprived of it no longer take any active part in the growth of the plant, but serve merely mechanical purposes, such as that of support or conduction, and are in that stage of their history filled usually with air or water. The pith of the Elder is made up of such dead cells, as is also the greater part of the wood and bark and older parts generally of all plants.

262. The most marked feature of the living protoplasm is its *activity*. We may observe this property by

Fig. 220.—Cells still older; *h*, the wall; *s*, vacuoles; *p*, protoplasm; *k*, nucleus; *xy*, swelling of nucleus caused by water used in preparation of the section. (Sachs.)

examining plant-hairs and other parts under high powers of the microscope, when it will be seen that there are movements of two kinds. The whole mass of protoplasm has a rotary motion, sliding upon the cell-wall, downwards on one side and upwards on the other. This is the *mass-movement*. Also, currents may be traced passing across the protoplasm in different directions. This is the *streaming-movement*.

In some of the very lowest plants, where there is no cell-wall, and the whole is a mass of naked protoplasm, these movements may be observed more readily because they are less restricted.

263. There is some doubt as to the exact chemical composition of protoplasm. It is, however, a very complex substance belonging to a group of bodies known as *albuminoids*, of which nitrogen is an important constituent.

The consistence of protoplasm depends upon the amount of water it contains. In dry seeds, for example, it is tough and hard, but when the same seeds are soaked in water it becomes partially liquid.


Fig. 221.

264. **Forms of Cells.** As cells become older they tend as a rule to change their form, though sometimes we find them differing but little from their original conformation. Commonly a cell grows more rapidly in some one direction, thus giving rise to long forms, as is the case in stems generally, and in the petioles and veins of leaves, the superior toughness and strength of which

Fig. 221.—Prosenchyma of the wood. (Gray.)

are due to the lengthening and hardening of the cells of which they are composed (Fig. 221).

265. **The Cell-wall.** In the portions of plants just selected for microscopic examination we have seen that the protoplasm is in every instance bounded by a wall. It has been ascertained that the wall is a chemical compound of carbon, hydrogen, and oxygen, and to this compound the name *cellulose* has been given.

We have said that the protoplasm is the active principle through the agency of which all the vital processes of the plant are carried on. It contains at some time or other every constituent of the plant. The cell-wall is itself, therefore, a product or *secretion* of the protoplasm, and is at first an extremely thin film, which, however, gradually increases in thickness by the addition of further material. This new material is deposited *between the molecules* of the original film, and so extends not only the surface of the wall, but, by deeper deposits, the thickness also. This process of acquisition of new material is known as *intussusception.*

266. As the wall between two cells increases in thickness, a distinct middle layer is discernible in it, known as the *middle lamella.* This portion of the common wall is different in chemical composition from the rest, so that it may, under proper treatment, be dissolved and the cells thereby separated.

267. It is in the earlier stages of their history, while the walls are comparatively thin, that the cells possess the greatest activity. By these alone is carried on the process of growth, which consists in the multiplication and enlargement of cells.

268. It is seldom the case that the wall is thickened uniformly. Often numerous round thin spots are left, so that the cell has a *dotted* appearance (Fig. 222). When the thin spots in adjacent cells are contiguous, as they commonly are, a ready means of intercommunication is afforded. Sometimes the spots, instead of being round, are oblong, so that the cell under the microscope presents a *ladder-like* appearance, and so is said to be *scalariform*. Then again, the thickening may take the form of *spiral bands* upon the inner surface; or, instead of a continuous spiral band, we may find a series of *isolated rings*, when the marking is said to be *annular*. *Reticulated* cells are also found, in which the markings, as the name implies, form a sort of network on the walls. Several of these forms are shown in Figs. 223 and 224.

Fig. 222.

269. Sometimes round thin spots will be left in the wall, and over each of these a thick-walled dome with an opening at the top will be formed. At the same time a similar dome is raised at exactly the same spot on the other side of the wall in the next cell; and, finally, the thin partition between the opposite domes breaks away, permitting free communication. Thus are formed what are called *bordered pits*, which abound in the wood of Conifers.

Fig 223.

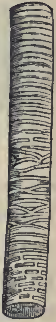

Fig. 224.

270. When cells stand end to end, and thin spots are

Fig. 222.—Dotted duct. (Gray.)

Fig. 223.—Spiral and annular markings on cell-wall. (Gray.)

Fig. 224.—Various markings on cell-wall. (Gray.)

left in the cross-partitions between them, *sieve-cells* are formed. Here, again, the thin spots finally disappear, thus practically uniting adjacent cells.

271. It sometimes happens that the thickening takes place throughout the length of a cell but in its *angles only*. Cells of this kind, which are often found immediately under the surface of the stem in the higher plants, are called *collenchyma* cells.

272. Besides the markings on the inside, cells often show markings on the outside. The pollen-grains of the Mallow, for instance, are seen under the microscope to be covered with pointed projections. Other pollen-grains, also, exhibit outside markings of different sorts.

273. The thickening deposit may be so excessive in some cases as to almost completely fill up the cavity of the cell (Fig. 225). The shells of nuts and the tough coatings of seeds consist of cells of this kind; but even in these cases the wall may be seen to be traversed by slender pores or canals, either simple or branched, radiating from the centre of the cell. To these hardened cells the name *sclerenchyma* is applied.

Fig. 225.

274. **The Contents of Cells.** If you look at Fig. 215, or, better still, if you have the opportunity of viewing a Moss-leaf through a good microscope, you will see that in the protoplasmic lining of the cells there are numerous greenish, rounded granules. These are the bodies to which the green parts of plants owe their colour. They are called *chlorophyll-granules*, and consist of protoplasmic matter in which particles of green

Fig. 225.—Sclerenchyma, the cell-cavity being almost obliterated. (Gray.)

colouring matter are embedded. The colouring matter itself is chlorophyll, and may be dissolved out of the granules, leaving the latter as ordinary protoplasm. Almost without exception chlorophyll requires the action of sunlight for its production, and the chlorophyll disappears from green parts when sunlight is withdrawn, as is well seen in the process of bleaching celery. In many of our brightly coloured foliage-plants the chlorophyll is concealed from view by other colouring matters. In flowers various colours are found in the protoplasm, but these, unlike chlorophyll, are produced in darkness as well as in sunlight.

275. Chlorophyll is of the utmost importance to the plant, seeing that only in the cells which contain it, and in the presence of sunlight, can the materials which the plant imbibes from the soil and the air be *assimilated*, that is, converted into matter which the plant can use for the purposes of growth.

276. Now consider Fig. 214. Here are exhibited cell-contents of an entirely different aspect. The rounded bodies here visible are *starch-granules*, as may be easily demonstrated by adding a drop of iodine solution to the Potato section under the microscope, a characteristic blue colour being at once produced. Such granules, differing somewhat in shape in different cases, abound in the cells of tubers and in grains of all sorts, where they have been stored up for use during the process of germination. They are originally formed during sunlight in the chlorophyll granules of the green parts. When the light is withdrawn, as at night, they are dissolved and carried in solution to other parts to promote growth or to be stored up.

277. If grains of wheat are masticated for a time it will be found that a portion remains in the mouth undissolved. This is because the starch of which the grain is so largely made up consists of two distinct parts: (1) a more soluble portion which is known as *granulose*, and (2) a less soluble part called *starch-cellulose.*

278. **Crystals.** These are of common occurrence in many plants, not only in the cell-cavities, but also imbedded in the substance of the cell-wall. They are also of various shapes, and may either occur separately or be massed together in clusters. The needle-shaped forms are known as *raphides.* These crystals consist for the most part of calcium oxalate, but calcium carbonate is also found, and may be readily distinguished from the former by the effervescence occasioned on the addition of hydrochloric acid. The oxalate dissolves in this acid without effervescence.

Crystals may be readily observed under the microscope in thin sections of scales from the Onion bulb, Rhubarb, Indian Turnip, and many other plants.

279. In the leaves of plants of the Nettle Family it frequently happens that a wart-like growth of cellulose takes place on the inside of the cell-wall, the inwardly projecting mass being attached to the wall by a slender stalk, and having multitudes of small crystals imbedded in it. Such inward growths are called *cystoliths;* they may be readily seen in cross-sections of the Nettle leaf.

280. **Crystalloids.** Seeds, especially those of an oily nature, as they approach maturity and become dry, develope in their cells multitudes of small rounded bodies of an albuminous nature known as *aleurone-grains*, and

these often envelope minute substances of crystalline aspect, which, however, under the action of potash and other re-agents, undergo such changes of form as to lead to the belief that they are not true crystals. They are called *crystalloids*, and are to be regarded as forms of protoplasm.

Occasionally crystalloids are observed without the albuminous envelope, as, for example, in the tuber of the Potato. Fig. 214 shows a cell having two or three such crystalloids of a cubical shape.

The aleurone-grains in seeds containing starch fill the spaces between the starch-granules. In oily seeds, such as the Brazil-nut, they replace the starch.

281. **Other cell-contents.** Besides the important substances already enumerated as products of the protoplasm, many others are found, such as sugar, inuline (a substance nearly related to starch, and found in a few special plants), fixed oils (castor, olive, linseed, &c., chiefly in seeds), essential oils (turpentine, oil of lemons, and essences of different kinds), gums, resins, and various acids.

282. **How new cells are formed.** There are several methods by which new cells are produced, but in the higher plants the common method is that of *cell-division.* We have already stated that only the newer thin-walled cells are capable of exercising this function. The process is briefly as follows: in the cell about to divide, the protoplasm first separates into two portions, each containing part of the nucleus; then a partition-wall of cellulose is developed between the two portions, thus forming two cells out of the original one. Each part then

enlarges and divides again, and so the process goes on. When cell-division takes place in one direction only, *filaments* or *threads* are formed; if in two directions, *surfaces* are formed; while division in three directions gives rise to *masses.*

It is evident that every part of a plant, however much altered in its later history, must in its earlier stages have consisted of this thin-walled cellular substance, or *meristem*, as it is called from its power of dividing.

283. Cell-division, then, is the method of new cell formation which prevails in the vegetative parts of the higher plants. In the production of pollen, however, and of the spores of vascular cryptogams, four new nuclei are formed in the cell, and the protoplasm collects about these, eventually secreting walls, so that four new and complete cells are formed *within* the original one, and these sooner or later make their escape. This mode is known as *free cell-formation.* In the production of the endosperm cells in the embryo-sac and the spores of many of the lower plants a similar process goes on; but here the division of the nucleus is not limited to four portions, as in the cases just mentioned, but may be carried on to an indefinite extent.

284. In some lower plants the entire contents of two adjacent cells may coalesce to form a single new cell. This mode is known as *conjugation.* Also, the contents of a cell may contract and develope a new cell-wall, a process known as the *rejuvenescence* or renewal of a cell.

285. **Tissues.** An aggregation of similar cells is called a *tissue.* Originally, every part of a plant consists of *meristem*, that is, of cells capable of dividing. But

changes set in, as we have seen, at a very early stage, and eventually all the cells assume *permanent* forms, some developing in one way, others in quite a different way, according to the function of each particular part. So that in any given plant we find tissues, or groups of cells, of very various kinds, and very different arrangements of these tissues in different cases. By examining sections taken in succession from the growing point backwards, every degree of change from meristem to permanent tissue may be made out.

286. In the growing parts of all plants, in the pulp of fruits, in the pith, in the green parts of leaves, and in the entire substance of many plants of low organization, we find tissue composed of short and comparatively thin-walled cells, to which the name *parenchyma* has been given. On the other hand, in the substance of wood, in the inner bark, in the petioles and veins of leaves, &c., we meet with tissue consisting of long, pointed, and overlapping cells, and known as *prosenchyma*. That of the wood is *fibrous* tissue, and that of the inner bark is the *bast*, specially characterized by the extraordinary length and flexibility of the cells. *Sclerenchyma* and *collenchyma* have already been referred to. In the former the cells are commonly, though not always, short; while in the latter they are usually long, but the ends are not pointed.

287. Cells have been described which are characterized by peculiar markings on their walls. When such cells stand end to end, the cross-partitions commonly disappear, with the effect of forming long tubes, generally of larger diameter than the other cells with which they

are associated. Such large cells are known as *vessels*, and tissue formed of them is called *vascular* or *tracheary* tissue. Hence we have *spiral*, *scalariform*, *annular*, *reticulated*, and *dotted* vessels. These different kinds of vessels are usually found associated with fibrous tissue, and the combination of the two is known as the *fibro-vascular system.*

288. Many plants, such as Dandelion, Blood-root, Milkweed, and Spurge, emit a coloured or milky juice when wounded. This juice is technically called the *latex.* It is contained in a special tissue which is peculiar to such plants, known as *laticiferous* tissue. Its form differs in different cases. In some instances it consists of long tubes which may or may not branch. In others, the cells composing it form a net-work. As in the case of vessels, the latex tubes are commonly formed by the coalescence of cells originally separate, but sometimes by the continued apical growth of single cells.

289. **Sieve-tissue** has been already noticed. The cells are usually rather wide, and the walls are not hardened, but the cross-partitions between the cells are thickened and perforated.

290. It may be added that *single cells* which resemble vessels in their markings are often spoken of as *tracheids.*

291. **Tissue-Systems.** While groups of similar cells are designated tissues, we may have also different combinations of these tissues in different plants, or in different parts of the same plant, and these various combinations are known as *tissue-systems.* These are now usually ranged under three heads: (1) *The Epidermal System*, including those combinations of tissue which go to

form the coverings of young stems, roots, and leaves; (2) *The Fibro-vascular System*, including such combinations as form the stringy masses which abound in the substance of the higher plants; and (3) *The Fundamental System*, including the combinations of cells which have undergone little or no change of form; in short, all the rest of the plant except the two systems first mentioned.

292. The **epidermal system** is most highly developed in Phanerogams. Fig. 226 shows a section through the thickness of a leaf. Here it will be observed that there is a closely-packed layer of cells forming the upper surface, and a similar layer forming the lower surface. These layers constitute the *epidermis* or skin of the leaf. The outer part of the epidermis is usually a continuous layer, and is known as the *cuticle*. It will be seen that the walls of these cells are much thicker than those of the cells in the body of the leaf, and also that the epidermal cells, unlike the interior ones, have been emptied of their protoplasmic contents and are rectangular in shape. It sometimes happens that the epidermis consists of two or three layers instead of one.

Fig. 226.

The outgrowths of the epidermis, included under the general term *trichomes*, have already been referred to; they must be regarded as part of the epidermal system.

Fig. 226. — Cross-section of a leaf, showing epidermis above and below, palisade cells under the upper epidermis, and loose tissue with intercellular spaces below the palisade cells. (Gray.)

293. An examination of the under surface of almost any leaf will show the presence of large numbers of oval openings, somewhat similar to that shown in Fig. 227. These are *stomata.* They are formed by two epidermal crescent-shaped cells with a space between them, and these have the power of separating or closing together according to circumstances; separating in the light, in moist weather, and closing in dry. The openings communicate with *intercellular spaces* in the body of the leaf, a number of which are seen in Fig. 226. In ordinary leaves with an upper and a lower surface, the stomata are far more numerous on the lower side; indeed, many such leaves are entirely without stomata on the upper surface. Vertical leaves have them rather equally distributed on both surfaces. Immersed leaves and underground stems have hardly any at all, and they are never found on roots. The use of the stomata will be referred to presently.

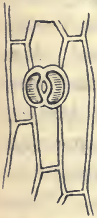

Fig. 227.

294. The stems of Dicotyledons lose their epidermis at a comparatively early period, and a tissue consisting of cells of *cork*, filled with air, takes its place. These cork-cells are modifications of the cells beneath the epidermis, and they form an effectual protection to the tissues within. The skin of the Potato-tuber exhibits this corky layer very clearly. The special tissue from which the cork is developed is called *phellogen.*

295. In the **fibro-vascular system** different plants exhibit a very different arrangement of the component

Fig. 227.—Stoma from the urface of a leaf, showing the crescent-shaped guard-cells.

tissues. As a rule, these tissues are capable of division into two groups, in one of which the wood is developed, and in the other the bast. To the former of these groups the general term *xylem* is applicable, and to the latter the term *phloem*. The xylem is made up of the elongated woody cells with pointed and overlapping ends, already referred to as fibrous tissue, the wide tubes (vessels) with variously marked walls, formed by the disappearance of the cross-partitions between cells placed end to end, and more or less short-celled tissue or parenchyma. The phloem is likewise made up of three constituents: the long, thick-walled, flexible cells called bast-cells, which correspond to the fibrous tissue of the xylem; the wide thin-walled sieve-cells, corresponding to the vessels; and a certain amount of thin-walled parenchyma.

296. The fibro-vascular *bundles*, as they are called, have their origin in the meristem of the growing point. This meristem is at first uniform, but soon groups of long cells arise in it, and these are then known as *procambium*, to distinguish them from the surrounding ground-tissue. This procambium is gradually converted into the fibro-vascular bundles.

Fig. 228.

297. In dicotyledonous plants, the fibro-vascular bundles are more or less wedge-shaped, as shown in Fig. 228. The inner part of each bundle consists of xylem and the outer of phloem, and between the xylem and the phloem there is a layer of meristem, known as the *cambium*. The soft cells of

Fig. 228.—Cross-section of a young dicotyledonous stem, showing six bundles.

the cambium divide, and the new cells thus continually being formed become modified on the one hand into tissues which increase the thickness of the xylem, and, on the other, into tissues which are added to the phloem. Later on cambium cells are formed in the ground-tissue between the bundles, thus linking together the cambium-layers of the various bundles, and forming a continuous ring. The links are then known as *interfascicular* cambium, that of the bundles themselves being the *fascicular*. Bundles of this kind, characterized by the cambium-layer, and so capable of continuous enlargement, are called *open* bundles.

298. In monocotyledons, on the other hand, there is no cambium-layer, and consequently the bundle when once formed is incapable of further increase, and so is said to be *closed*. Fig. 229 is a representation of the cross-section of an endogenous stem in which many of these closed bundles are visible. Of course in such stems no bark is formed.

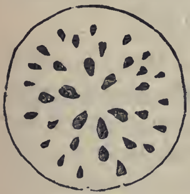

Fig. 229.

299. It has been explained that in the exogenous stem the xylem occupies one side of the fibro-vascular bundle, while the phloem occupies the other. In the closed bundles of Ferns and Club-Mosses, as well as of some monocotyledons, however, a different arrangement prevails, the xylem occupying the central part of the bundle, and the phloem forming a circle around it. The former arrangement is described as *collateral*, while the latter is *concentric*. In many of the monocotyledons, as well as in the exogens, the bundles are collateral.

Fig. 229.—Cross-section of monocotyledonous stem, showing closed bundles.

300. Fig. 230 shows a section of an exogenous stem somewhat older than that shown in Fig. 228. Here new bundles have been formed between the earlier ones, so that the whole centre of the stem, except the *pith* and the lines radiating from it, is occupied by the wood. This cylinder of wood is now encircled by a ring of cambium, beyond which are the tissues of the phloem.

Fig. 230.

301. The appearance presented by the cross-section of an exogenous stem is that of a series of concentric rings, each ring showing the limit of a year's growth. The portions of wood formed late in the summer are more compressed by the outlying tissue than those formed in spring, and hence the outer part of each year's ring appears denser, and is sharply marked off from the ring of the following year. No growth of the cambium takes place in winter. The rays which intersect these rings as fine lines consist of portions of the ground or fundamental tissue which have been squeezed into their present form by the increasing fibro-vascular bundles on each side of them; they are called *medullary rays*, and, as the stem grows, new ones are formed from the cambium. Only the *primary* ones, however, extend from the pith to the bark; those formed later are shorter.

302. In roots a special arrangement of the tissues of the bundles prevails, the xylem and phloem forming alternate *rays*. This is the *radial* arrangement.

303. The **fundamental** or **ground tissue** comprises all the parts of the plant not already included in

Fig. 230.—Section of an older dicotyledon, the bundles now forming a ring.

the epidermal and fibro-vascular systems. In the exogens it embraces the pith, the medullary rays, and parenchyma generally. The collenchyma found just beneath the epidermis, sclerenchyma occurring in different parts, and laticiferous tissue are also constituents of the fundamental system, as well as the cork cells already referred to. In the monocotyledons ground-tissue in the form of parenchyma fills the space between the closed bundles of the stem; while in many plants in which fibro-vascular bundles are not produced, the ground-tissue constitutes the whole of the interior.

304. In exogenous stems the wood developed from the cambium is often different from that of the primary bundle as developed from the procambium. Pines, for example, have vessels in the primary xylem, but none in the secondary, the latter being almost entirely made up of the cells with *bordered pits*, already described.

305. The bundles of the leaves are continuous with bundles in the stem. Leaves appear at first as protuberances on the side of the stem close to the growing point, and the upper ends of the primary bundles almost at the very beginning bend outwards towards the new leaves, the lower part being continued down the stem. In the monocotyledons these bundles first arch inwards towards the centre of the stem, and then outwards and downwards, thinning out as they descend. Hence, in a cross-section (Fig. 229) the bundles appear more crowded towards the circumference, and also smaller. Such a stem is, therefore, found to be harder at the outside than at the centre.

CHAPTER XX.

FOOD OF PLANTS—CHEMICAL PROCESSES—MOVEMENTS OF WATER—PHENOMENA OF GROWTH.

306. The materials of which the substance of a plant is made up are various, and some of them occur in far larger quantities than others. Water forms a very considerable percentage of the whole weight, but is present to a greater extent in some portions of a plant than in others. Fleshy roots, for example, may contain as much as 90 per cent. of water, while dry seeds contain only about 12 per cent.

307. The water may be expelled by careful drying, and if what is left is then burnt, what is called the *organic* part of the plant disappears, and a small quantity of *ash* remains behind. The organic part is found to consist mainly of carbon, hydrogen, oxygen, nitrogen, and sulphur; while the inorganic part (or ash) contains very small quantities of phosphorus, iron, calcium, magnesium, and potassium. All these materials are obtained from the air or the soil. There is constantly present in the air carbonic acid gas, a compound of carbon and oxygen, which is exhaled from the lungs of animals, and which is always found wherever wood or coal, or carbon in any form, is being burned. This gas is carried down into the soil dissolved in rain-water, and the solution is then absorbed by the roots and transmitted by the stem to the leaves, where, in the presence of chlorophyll and in sunlight, the gas is decomposed into its carbon and oxygen. The excess of oxygen is then exhaled and the carbon chemically combined with the other elements to

form starch for purposes of growth. The oxygen required by the plant is derived chiefly from the carbonic acid gas and from water. Hydrogen is obtained by the decomposition of water, and nitrogen from the ammonia, which, like the carbon dioxide, is carried down from the air by rain, and also from nitrates contained in the soil. Sulphur is obtained from salts (such as calcic sulphate) found in the soil, as are also, of course, all the inorganic elements.

Of all these constituents of the *dry* plant, carbon is the most abundant, amounting to about half of the entire weight.

308. The inorganic elements, though small in quantity, are, nevertheless, essential. If, for example, a plant be altogether deprived of iron it will produce no chlorophyll; while, if potassium is withheld, it will not produce starch. These facts are proved by causing seeds to grow under conditions which enable us to accurately control the supply of nutrition in the form of carefully prepared solutions of the different ingredients. Several substances of common occurrence in the ash of plants, as silica, sodium, and some others, are in this way shown not to be essential to healthy growth.

309. The process by which the carbon, obtained from the carbon dioxide, is combined with the elements of water to form starch is called *assimilation*. As already explained, the particles of starch which are formed by the chlorophyll granules in sunlight are converted by combination with oxygen into soluble forms, and carried away, when the light is withdrawn, to other parts where growth is going on, or to storehouses such as tubers and seeds. This oxidising and converting process is *metastasis*.

In consequence of having such a store of material, tubers can grow in the dark as long as the material holds out, but will not, of course, produce green leaves.

Besides starch, oil is a common form of reserve material, particularly in seeds. Sugar, also, is found; as, for example, in the Sugar-Beet.

310. Parasites and saprophytes, which are as a rule without chlorophyll, do not assimilate, but obtain their nourishment from the stores of other plants or from decomposing organic matter.

311. The so-called carnivorous plants, such as the Bladder-wort and the Pitcher-plant, obtain a portion of their nitrogen by entrapping insects and other small animal organisms, and absorbing them as they decompose. Some such plants appear to cover their prey with an acid secretion, and to go through a digestive process not altogether unlike that performed by animals.

312. **Respiration.** Plants, like animals, are continually inhaling oxygen, and the presence of this gas is essential to their existence. The oxygen so inhaled is combined with carbon to form carbon dioxide, and this in the day-time is at once decomposed and the carbon assimilated. The absorption of oxygen and its subsequent combination with organic matters in the plant is accompanied by evolution of heat, a fact well illustrated in the process of malting, where damp barley is heaped together. As soon as the grain begins to sprout, oxygen is rapidly absorbed, and a very decided rise of temperature takes place. The starch of the grain is oxidised and converted into sugar, and the growth is then stopped by rapid drying. The sugar, on fermenting, produces alcohol.

313. Transpiration. The openings in the epidermis, called *stomata*, have already been described. Through these the excess of water-vapour in the plant is exhaled. It may often be observed, in hot, bright weather, that the leaves of plants droop if exposed to the sun. This is because the rate of evaporation through the stomata is greater than the rate of supply at the roots. At night, however, the stomata close and the balance being restored the plant recovers. The water which is thus supplied to the leaves appears to be conveyed through the stem by means of the *cell-walls* of the wood-prosenchyma, since the supply is not diminished if a ring of bark and the underlying bast and cambium be removed.

314. But water is also supplied to the growing points, and in a different way. It is well known that if two liquids (or gases) of different density are separated by a porous diaphragm they will tend to change places, the fluid of less density passing through the diaphragm more rapidly than the other. This is the principle of *osmose*, and wherever in a plant a cell-wall separates cell-contents of different density it is found to apply. Hence, water is absorbed by freshly-formed cells, containing dense protoplasm, from neighboring cells which are a little older and in which the protoplasm has been diluted. These absorb from the older cells behind them, and so on. Such water is transmitted, not through the prosenchyma of the wood, but through the parenchyma and the meristem.

315. It is a matter of common observation that the stems of many plants "bleed" if cut in the spring. This is due to the upward pressure of the water with which the roots are charged at that time, and it takes place in the

absence of transpiration. When the leaves are formed and transpiration sets in actively, the root-pressure is relieved and the stems will no longer bleed immediately on being wounded. In some plants the excessive root-pressure even causes drops of water to exude from the leaves.

316. We may observe, then, three distinct movements of water in the plant: (1) the rapid movement to make up for the loss by transpiration, (2) the slow movement to supply the growing cells with requisite moisture, and (3) the movement due to root-pressure.

317. **Growth.** Growth has already been referred to as consisting in the formation and subsequent enlargement of new cells, accompanied in many cases by change of form. It has also been mentioned that the enlargement is the result of the introduction of new particles of vegetable material into the spaces between the molecules of the parts already formed—a process known as intussusception. It is now generally admitted that each of the molecules of which the plant-body is made up is enveloped in a sheath of water. We know that the presence of water is essential to growth; when it is absorbed by a growing cell the immediate effect is to stretch the cell, as it were, to its utmost capacity; in other words, to separate the molecules as far as possible and so increase the amount of water between them, thus making it possible to interpose new molecules of solid matter. The use of the water, also, as a vehicle for conveying the new material is obvious. This new material, the presence of which is essential to growth, is commonly supplied to the growing points from older parts which serve the purpose of storehouses, as seeds and tubers, or of manufactories, as the leaves.

318. Stems and roots, as a rule, exhibit three distinct regions according to the stage of development at which they have arrived. There is, first, the growing point, the chief characteristic of which is the rapid formation of new cells by division; secondly, the elongating part, chiefly characterized by the growth of the cells in length, there being practically no further division here; and, thirdly, the fully developed part, in which there is no further division or enlargement, though the cells may continue to discharge various important functions.

319. Growth, whilst dependent upon an adequate supply of water and of new material, is also largely affected by external conditions, such as temperature and light. Growth may be stopped altogether by either too low or too high a temperature, and between the limits within which any given plant is found to be capable of growth there will be found a particular degree of temperature more favourable to growth than any other either above it or below it. This may be called the *optimum.* The effect of temperature differs considerably according to the amount of water present in the part affected, dry seeds, for instance, resisting a temperature, either high or low, to which soaked seeds would at once succumb.

320. Light is essential to assimilation, but seeds and tubers, as well as many of the lower plants which are without chlorophyll, such as Mushrooms, will grow in the absence of light as long as the stock of assimilated material upon which they draw is not exhausted. The growth which takes place in the cambium-layer of dicotyledons and in roots is another example of increase in size in the absence of light. The assimilated material

in all these cases, however, has been previously elaborated elsewhere.

321. Light is found to exercise a retarding influence upon growth. A plant, for instance, in a window will bend towards the light, because the cells on the side nearest the window grow more slowly than those which are shaded, thus causing curvature of the stem and petioles.

322. Gravitation also affects growth, as we know that the stem and root, or *axis* of the plant, are usually in the line of the radius of the earth at the place of growth. If a seedling plantlet be laid with the stem and root horizontal, the stem will curve upward and the root downward in the endeavour to restore the vertical direction.

323. The twining movement of the stems of many plants is due to inequality of growth at successive points in the sides of the stems. Leaves unfold from the bud because the growth on the upper side at the time of unfolding is more rapid than on the under side. These movements are called *nutations*, and are not due to the external action of light, but entirely to internal causes. The movements of tendrils, however, are affected by contact with the object which they grasp.

CHAPTER XXI.

EXAMINATION OF A FERN—A HORSETAIL—A CLUB-MOSS.

324. We shall now proceed to the examination of some common plants which will be found to be typical of groups differing in important respects from the phanerogams.

Ferns. Fig. 231 is a representation of our common Polypody. You may find it in almost any shaded rocky place. Running horizontally beneath the surface you will find the stem of the plant, which in this case is, therefore, a *rhizome.* A portion of the rhizome is shown in the lower part of the figure, with fibrous roots on the under side. From the upper side are developed the leaves, which, as you see, have long petioles, and if you find one which is still in the bud you will observe that it is rolled up lengthwise, as shown in Fig. 232. The vernation is, therefore, *circinate*, and this is the case in nearly all the Ferns. On examining the back of the leaf (Fig. 231 shows the back) we observe rows of brownish dots on each side of the middle veins of the upper lobes. Fig. 233 is an enlarged view showing the position of these dots at the extremities of the veinlets. When we put one of these dots under the microscope it is seen to be a cluster of minute, stalked bodies, such as that shown in Fig. 234. These bodies are further found to be sacs filled with extremely fine dust, and the dust consists of multitudes of rounded particles all exactly alike. They are, in short, *spores*, and the sacs in which they are contained are the spore-cases, or *sporangia ;* while the clusters of sporangia are the *fruit-dots*, or *sori.* Around each sporangium there is an elastic jointed ring which breaks at maturity, and by its elasticity ruptures the spore-case, which then discharges its spores, as shown in Fig. 234. The leaf of the Fern, then, is something more than an ordinary foliage-leaf, and is known as the *frond.* The petiole is called the *stipe*, while the mid-rib is the *rhachis.*

325. A spore under proper conditions developes a slender thread-like cell which eventually gives rise to a thin, flat, green expansion, resembling that shown in Fig. 235. This is called the *prothallium.* From the under surface root-hairs are produced as shown in the figure. On the same surface, among the root-hairs, arise minute projections

Fig. 233.

Fig. 234.

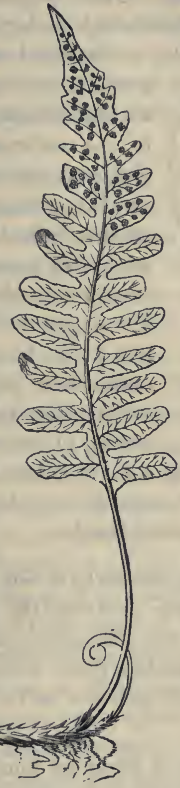

Fig. 231.

Fig. 232.

Fig. 231.—Root-stock and frond of Polypody.
Fig. 232.—Circinate vernation of the frond.
Fig. 233.—Magnified view of the sori.
Fig. 234.—Sporangium discharging spores; greatly magnified.

of tissue in which are developed cells corresponding to the pollen-grains of phanerogams. These projections are the *antheridia;* they contain cells in which are fertilizing bodies known as *antherozoids.* Also on the under surface of the prothallium, near the notch, we find structures analogous to the embryo-sac of the phanerogamous ovule. These are the *archegonia.* They are mostly flask-shaped bodies, having a germ-cell—the *oosphere*—in the lower end. The antherozoids, on escaping from the antheridia, make their way down the necks of the archegonia, and coming in contact with the oospheres fertilize them. As a result of this fertilization, a plant is developed in all respects like the one which originally bore the spores on its fronds.

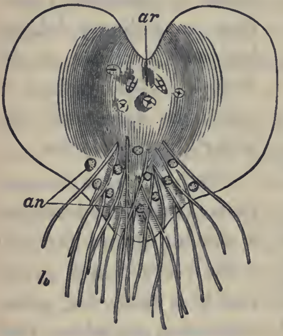

Fig. 235.

326. It is manifest, then, that we have here two distinct *generations*: first, the spore produces the prothallium which bears the antheridia and archegonia; secondly, the interaction of these gives rise to a plant which bears the spores. This phenomenon is spoken of as the *alternation of generations.*

327. The stems and roots of Ferns are found to contain vascular bundles which, like those of monocotyledons, are closed.

Fig. 235.—Prothallium of a Fern, under side; *h*, root-hairs; *an*, antheridia; *ar*, archegonia. Magnified 10 times. (Prantl.)

328. From the account here given of the mode of reproduction in the Ferns, it will be evident that the Gymnosperms occupy an intermediate position between them and the Angiosperms.

For a description of other common Ferns differing in detail from the Polypody, the student is referred to Part II., page 169.

329. **The Horsetails.** At page 181. Part II., will be found a description of the common Horsetail, with an illustration of the fertile stem, or rather branch, because both the pale spore-bearing branch and the later green shoots with whorled branches are sent up from an underground stem or rhizome. The spores, upon germination, give rise to prothallia bearing antheridia and archegonia precisely as in the Ferns. The prothallium is usually small, flat, and irregularly branched or lobed, developing the antheridia at the projecting ends of the lobes, and the archegonia in the angles between them ; or, in other cases, the prothallia may be diœcious. Fertilization of the germ-cell, which occupies a cavity at the base of the archegonium, takes place exactly as in the Ferns, and, as a result of fertilization, the germ-cell developes into a spore-bearing plant similar to the original one. Here, therefore, we have again exhibited an alternation of generations.

Other species of Equisetum of common occurrence, instead of producing a special fertile branch, develope sporangia at the extremities of the ordinary leafy stems.

330. These plants, like the Ferns, exhibit fibro-vascular bundles, and the epidermis is especially characterized by the excessive amount of silica contained in it, some of the species being used for scouring or polishing by reason of this property.

331. The curious *elaters* (Fig. 236) attached to the spores doubtless assist them to escape from the spore-cases, and subsequently aid in dispersing them.

Fig. 236.

332. **The Club-Mosses.** Fig. 237 is a representation of a branch of *Lycopodium clavatum*, one of our common Club-Mosses. The creeping stem lies flat upon the ground, and often attains a great length, sending up at intervals erect branches with crowded linear-awl-shaped leaves, some of which, like the one shown in the figure, are terminated by a slender peduncle bearing one or more cylindrical spikes. These are the fertile branches, and the leaves upon them, or at all events upon the slender upper part, are very much smaller than upon the ordinary sterile branches.

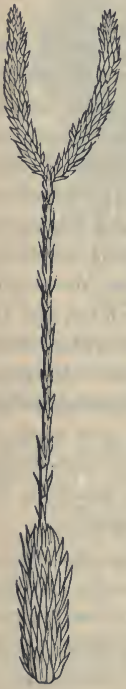

Fig. 237.

It is to be observed that the stems and roots of these plants branch *dichotomously* (145,.

333. The sporangia are produced in the axils of the leaves of the terminal spike. One of these leaves, greatly magnified, with its attached sporangium, is shown in Fig. 238. The sporangium opens by a slit at the top to discharge the spores.

334. It is only quite recently that the prothallium has been detected. It is described in the case observed as a "yellowish-white

Fig. 236.—Spore of Equisetum with elaters; highly magnified.
Fig. 237.—Branch of *Lycopodium clavatum*; natural size. (Thomé.)

irregular lobed body, sparingly furnished on its under surface with small root-hairs." The antheridia and archegonia

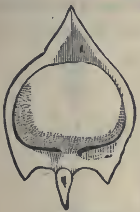

Fig. 238.

appear to be produced on the upper surface, and these by their interaction, give rise to the new plant which bears the spores, just as in the Ferns and Horsetails ; so that again there is an alternation of generations.

335. It is a fact of great interest that in some plants nearly related to the Club-Mosses, *two kinds* of spores—large and small—are produced in separate sporangia. The large ones develope prothallia upon which archegonia are formed, and the smaller others upon which antheridia appear.

336. The three plants just considered, while evidently differing in certain details of structure and in general aspect, nevertheless have a number of characters in common :

1. *They agree in their mode of reproduction, which is by spores, these bodies being quite unlike the* SEEDS *with which we are now familiar, and which, you will recollect, always contain the embryo of the new plant.*
2. *They all exhibit an alternation of generations.*
3. *They all have true roots.*
4. *The three tissue-systems—the epidermal, the fibro-vascular, and the fundamental—though not all developed to so high a degree as in the Phanerogams, still can be very clearly made out in both roots and stems. The fibro-vascular bundles are always closed, as in monocotyledons, and are, as a general rule, concentric (299).*

Fig. 238.—Leaf of *Lycopodium* bearing sporangium ; greatly magnified. (Thomé.)

337. Plants with these common characteristics constitute a group called **Pteridophytes** or **Vascular Cryptogams,** "cryptogam" being a general term applicable to all plants which do not produce true flowers, as "phanerogam" applies to all those which do.

CHAPTER XXII.

EXAMINATION OF A MOSS AND A LIVERWORT.

338. **Mosses.** Fig. 239 is a representation of the common Hair-Moss (*Polytrichum commune*), which may be found in early summer almost anywhere. It grows in dense masses, and upon examination it will be found that while many of the stems resemble that shown in Fig. 239, the upper extremities of others form rosettes, as in Fig. 240, whilst others again terminate in ordinary vegetative buds.

339. Let us first examine a specimen as represented in Fig. 239. There is, it will be observed, a well-marked stem, or leaf-bearing axis, upon which the crowded minute leaves are sessile. In the Mosses they always are so, and they are found, upon examination with a good microscope, to consist as a rule of only one layer of cells, being therefore much simpler in structure than those of the plants we have so far been engaged upon. It is also to be noticed that the leaves of Mosses are without stomata.

340. Observe now that our Moss has no true roots. It is, however, fixed to the soil upon which it grows by numerous root-hairs or *rhizoids.*

341. The slender scape-like stalk which rises above the leaves is technically called the *seta*, or bristle; in the left-hand part of the figure (*c*) the upper end of the seta is covered by a hairy cap, the *calyptra*. In the right-hand portion the calyptra has been removed, disclosing a little pod, variously spoken of as the *theca*, or *urn*, or *capsule*, or *sporangium*. Fig. 241 is an enlarged view. This capsule is closed at the top by a circular lid, the *operculum*, which falls away when the capsule is mature, thus allowing the escape of the *spores*, which are produced in it. The spores are developed upon the surface of a central column which rises from the bottom of the capsule, and which is known as the *columella*. The opening through which the spores escape is called the *stoma*, and a good lens reveals the fact that around the stoma there is a circle (sometimes two) of minute teeth, known collectively as the *peristome*. In the Moss now before us the peristome consists of sixty-four teeth. In other Mosses the number varies, being always, however, some power of 2; either 4, or 8, or 16, or 32, or 64. Occasionally the teeth are altogether absent.

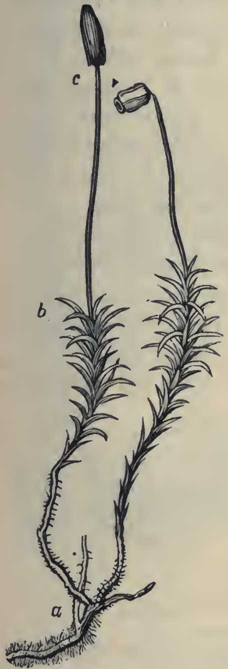

Fig. 239.

Fig. 239.—Two fertile stems of a Moss (*Polytrichum commune*) of the natural size; at *c* the calyptra is seen enveloping the capsule. (Wood and Steele.)

342. We shall now consider the mode of reproduction in the Mosses. Let us commence with the spore. This, upon meeting with proper conditions, bursts its outer coat (the *exospore*), and the inner coat (the *endospore*) is then protruded as a slender tube. This continues to grow by repeated division, until at length, in most cases, a tangled thread-like mass of vegetation is produced, to which the name *protonema* has been given. After the lapse of several days minute buds are developed at different points upon the protonema, and these are found to consist of whorls of scaly leaves. This is the beginning of the development of the ordinary Moss-plant. Upon the plants thus arising from the buds are developed antheridia and archegonia, the former in the axils of the leaves forming the rosettes shown in Fig. 240, and the latter at the apex of other stems, as shown in Fig. 239. The antheridia are seen under the microscope to be club-shaped bodies, containing a mass of cells in which the antherozoids are formed. The archegonia are flask-shaped bodies, with a lower expanded portion and a long neck above. Fig. 242 shows the apex of a fertile

Fig. 240.

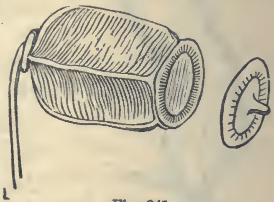

Fig. 241.

Fig. 240.—Apex of sterile stem, showing rosette of perigonial leaves, in the axils of which are the antheridia; greatly enlarged.

Fig. 241.—Enlarged view of capsule, showing peristome and detached operculum. (Wood and Steele.)

stem with several archegonia in the centre, and Fig. 243 shows a single archegonium very highly magnified. The antherozoids upon being set free make their way down the necks of the archegonia, and unite their substance with that of special cells in the lower end (one in each archegonium). These cells, as a consequence of being thus fertilized, become surrounded by a thin coat and immediately begin to grow upwards, developing the slender stalks (setæ) with the capsules at the summit, and surmounted by the calyptra, which is, in fact, nothing but the wall of the archegonium which is torn away at its base and carried upwards. Then the spores are developed around the columella, and the round of life of the plant is completed.

Fig. 242.

Fig. 243.

As in the Ferns, we have here also exhibited an alternation of generations, the one generation being that arising from the development of the spore and resulting in the production of the antheridia and the archegonia; the other being that arising from the fertilization of the

Fig. 242.—Enlarged view of apex of the fertile stem of a Moss; *a*, archegonia; *b*, leaves.

Fig. 243.—Very highly magnified view of an archegonium; *b*, the base; *h*, the neck; *m*, the mouth; the germ-cell is seen at the bottom of the flask-shaped cavity. (Sachs.)

special cells in the archegonia, and resulting in the production of spores.

343. **Liverworts.** Figs. 244 and 245 are representations of portions of a very common Liverwort, *Marchantia polymorpha.* It may be found growing along the borders of marshes and in wet places generally, often with intermingled moss. It is of a deep green colour, and usually spreads over a considerable extent of surface. There is no appearance of leaves, the plant-body lying flat upon the surface upon which it grows, and putting forth root-hairs on the under side. From the upper side arise peculiar stalked bodies of two sorts, as shown in the figures; the one consisting of flattened or slightly convex disks, and the other being star-shaped. These stalked bodies contain the reproductive organs. In cavities on the upper surface of the flattened disks are produced the antheridia, from the cells of which are liberated the antherozoids. On the under surface of the rays of the star-shaped bodies are produced clusters of flask-shaped archegonia, each with a germ-cell at its base, and fertilization takes place in the manner already described in the account of the Moss. As a result of fertilization a capsule is developed which produces spores,

Fig. 244.

Fig. 244.—Portion of a Liverwort (*Marchantia polymorpha*), showing the thallus and several stalked disks which bear the antheridia; natural size. (Thomé.)

pretty much as in the Mosses, though in *Marchantia* the stalk of the capsule is very short, and the whole is surrounded by a loose sheath which grows up from the base and at length completely encloses it. The spores on germinating develope into plant-bodies such as we have described, so that the alternation of generations is here also well marked.

Fig. 245.

344. Other Liverworts more nearly resemble the Mosses in form, having leafy stems, from the summit of which arise slender stalks with capsules at the upper end. These capsules, however, do not open by a stoma, but are four-valved, and at maturity the valves split asunder, allowing the escape of the spores. In the leaves of these latter forms there are no veins of any kind. Forms in which the plant-body is a flat expansion, as in *Marchantia*, are distinguished as *thalloid*, while the leafy forms are said to be *foliose*.

345. It remains to be added that *Marchantia* and other Liverworts reproduce themselves by buds as well as by spores. These buds *(gemmæ)* are formed in little cup-shaped receptacles which appear on the upper surface of the plant-body. They consist of simple masses of tissue, which fall away when fully grown, and immediately develope into new plants.

Fig. 245.—Thallus with star-shaped receptacle bearing archegonia; natural size. (Thomé.)

346. The Mosses and Liverworts constitute a distinct group of plants called **Bryophytes.** It will be evident from the preceding descriptions that in the matter of reproduction they do not differ materially from the Pteridophytes. They are, however, distinctly separated from them by the *simpler organization of their tissues.* The Bryophytes have no true roots, but only root-hairs or rhizoids. The whole plant-body is, as a rule, composed of thin-walled parenchyma, and only in a few cases is there any appearance of a development of a fibro-vascular system, and that only of the vaguest possible kind. There is, however, a well-defined epidermal system, and stomata are not uncommon.

CHAPTER XXIII.

EXAMINATION OF A MUSHROOM—A LICHEN—A CHARA.

347. **Mushroom.** Fig. 246 is a representation of the Common Mushroom of the natural size, while Fig. 247 shows the several stages of its growth. At *A* is seen a matted fibrous mass, which is the underground portion of the plant. It is called the *mycelium;* at several places on it rounded outgrowths of different sizes are visible. These eventually develope into the overground part of the Mushroom. At *II* is shown a vertical section through one of these outgrowths at an early stage; at *l* in this figure you will observe two dark dots; these are the open ends of a channel which forms a complete ring

in the interior. At *III* they are much more distinct, and here is also manifest a difference between the upper and lower sections, which is still more marked at *IV* and *V*. The upper spreading portion is called the *pileus;* at *V* the lower edge of the pileus is still attached by a circular membrane to the stalk. In this stage the membrane is

Fig. 246.

called the *veil;* later on, as seen in Fig. 246, it is torn away from the pileus and now forms the *annulus*, or ring, about the stalk. Upon the under side of the pileus are produced a great many vertical, thin plates, called *lamellæ* or *gills.* If we make a vertical section through the pileus so as to cut across a number of the lamellæ, they will

Fig. 246.—The Common Mushroom (*Agaricus campestris*); *a*, the pileus; *b*, the lamellæ; *c*, the annulus. (Thomé.)

present the appearance shown at *A*, Fig. 248, and if we magnify one of these cross sections it will appear as at *B*,

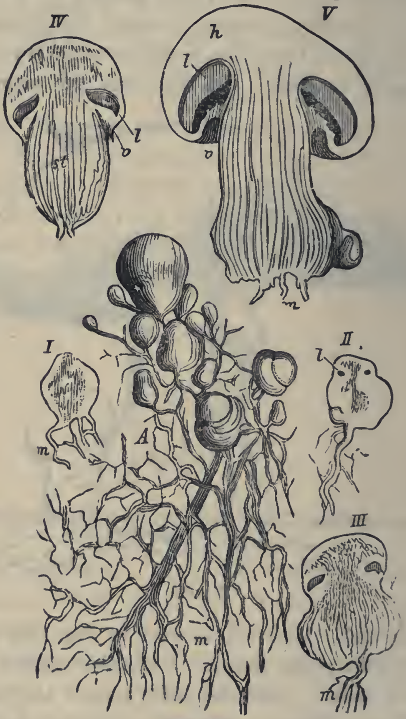

Fig. 247.

where there is seen an outer layer of cells standing on end. The whole of both surfaces of the lamellæ is covered with such cells, and this special layer is the

Fig. 247.—Various stages in the development of a Mushroom. (Sachs.)

hymenium. At *C*, the left hand portion of the figure shows a number of these long cells much more highly

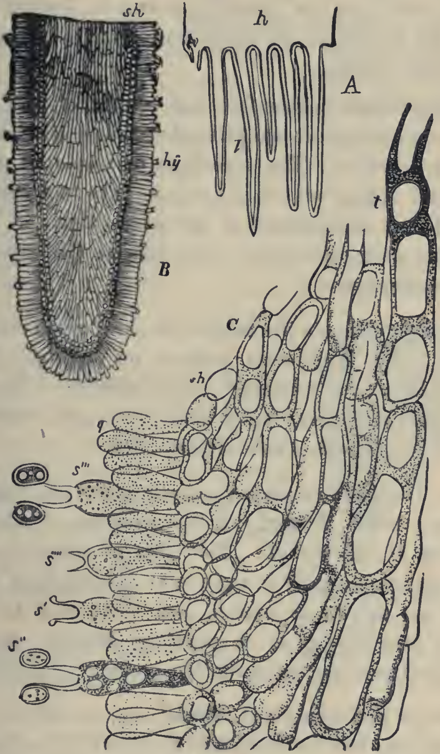

Fig. 248.

magnified, some of them narrowed in at the top so as to form slender points, upon each of which is a rounded body.

Fig. 248.—Greatly enlarged views of sections of the lamellæ of a Mushroom. (Sachs.)

These rounded bodies are the *spores;* the narrowed ends of the cells are called *sterigmata*, and the projecting cells which bear them are specially known as *basidia.* The spores are formed by the simple narrowing in of the outer ends of the basidia.

The mycelium is, therefore, the vegetative part of the Mushroom, while the stalked pileus above the surface is the fructification. The mycelium is developed directly from the spore, but so far there have not been discovered any indications of the interaction of sperm-cells and germ-cells such as characterize the Bryophytes and Pteridophytes.

348. You will note the entire absence of green colouring-matter. The Mushrooms produce no chlorophyll, and, consequently, are incapable of assimilation. They are always found growing upon decaying organic matter, as the leaf-soil of forests and meadows, &c.

349. The Mushrooms are representatives of a large class of plants called **Fungi**, all the members of which are destitute of chlorophyll. The cells of which they are made up are generally in rows so as to form long threads which are known as *hyphæ*, and these may be either loosely interwoven, as in ordinary Moulds, or firmly compacted together, as in the Mushroom.

350. As just mentioned, Mushrooms are saprophytic in their habits; but there are also Fungi which are parasitic, such as Rust and Smut. To the Fungi belong such organisms as the Yeast-plant, and the Bacteria which are found in putrefying matter, and are the cause of, or are associated with, diseases of various kinds.

351. **Lichens.** These plants may be found growing on the bark of trees, on old fences, on rocks, or on the ground. They differ widely in external appearance, sometimes growing erect and imitating a stem and branches, as in Fig. 249; sometimes forming flat expansions which adhere to the surface upon which they grow, as in Fig. 250. Some species are yellow, others red, others grey. A very common one is that represented in Fig. 250. It may be found upon many tree-trunks, and will be easily recognized by the yellow disks which dot its surface.

Fig. 249.

352. The flat part of the Lichen is the thallus, or vegetative portion, while the yellow, cup-shaped disks (the *apothecia*) contain the fructification. Fig. 251 shows a section of the apothecium, and also the lobing of the margin of the thallus. Fig. 252 is a very highly magnified view of a section of a thallus, showing it to be largely made up of cells, or *hyphæ*, similar to those of the Mushroom. But in the Lichen there are visible, in addition, large numbers of spherical *green* cells (*g g* in the Fig.) known as *gonidia*, which either occupy well-marked

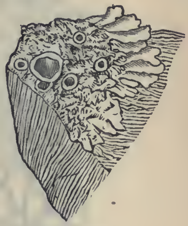
Fig. 250.

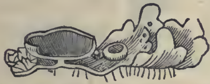
Fig. 251.

Fig. 249.—A fruticose Lichen (*Cladonia digitata*) of the natural size; *b*, the cup; *c*, the thallus; the rounded bodies at the summit are the apothecia. (Thomé.)

Fig. 250.—A foliaceous Lichen growing on a stone; natural size. (Gray.)

Fig. 251.—Section of an apothecium. (Gray.)

layers, as in the present instance, or are scattered through the body of the thallus. The presence of these gonidia may be said to be the distinguishing feature of the Lichens. Their true relation and function were for a long time doubtful, widely different opinions being held, but

Fig. 252.

it is now generally admitted that the gonidia are themselves *chlorophyll-bearing plants*, and that the remainder of the Lichen is a true Fungus, *parasitic upon the gonidia.*

Fig. 252.—Very highly magnified view of section of the thallus of a Lichen; *r*, rhizoids; *m*, spurious tissue of hyphæ; *g*, green gonidia; *o*, boundary cells of upper side; *u*, boundary cells of under side. (Sachs.)

The question as to the origin of the gonidia is not yet settled.

353. The structure of the apothecium is very well shown in Fig. 253. From the hyphæ are developed large, club-shaped, vertical cells (the *asci*) which penetrate between the narrower vertical branches of the hyphæ (the *paraphyses*). In the asci arise the spores (technically, *ascospores*), usually eight in each, and these when mature are discharged from the asci, and give rise to new plants. The ascospores are formed in the asci by the process known as *free cell-formation* (283). The protoplasm in the asci collects about as many different points as there

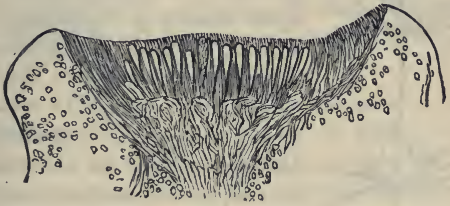

Fig. 253.

are spores to be formed, and a wall is then secreted about each. This mode, which is characteristic of a large number of Fungi, is quite distinct from that which prevails in the Mushrooms, where, as we have seen, the spores are formed by *abstriction*.

354. **Chara.** Fig. 254 represents a Chara of the natural size. It grows almost everywhere in fresh waters, and is quite readily distinguished from other thread-like

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Fig. 253.—Very highly magnified view of section o an apothecium, showing the club-shaped asci. (Thomé.)

Fig. 254.

aquatics by the whorls of so-called leaves which encircle the stem, and also by the general gritty nature of the plant. A very offensive odour is emitted by the plant in the course of decay. Its green colour shows at once the presence of chlorophyll. On the branches you may observe numbers of minute, more or less rounded, bodies; Fig. 255 is an enlarged view of one of them. Here, at *b*, is shown a large central nucleus (the *nucule*) enclosed in a spiral covering. This spiral consists of five long cells side by side, all of which wind about the central body, and have their ends projecting above it. The nucule is a row of cells of which the highest is the germ-cell, and the whole answers, in fact, to the archegonium of the Bryophytes and Pteridophytes. It is, in this plant, called the *carpogonium*. Just below it is a globular body made up of eight triangular shield-shaped segments arranged about a central cavity. From the inner end of each segment several coiled filaments of many cells each project into the cavity. At maturity the shields separate, and the filaments eventually break up into their

Fig. 254.—*Chara fragilis*; natural size. (Thomé.)

constituent cells, each of which then liberates an antherozoid. The antherozoids make their way down the necks of the carpogonia and fertilize the germ-cells. The spiral cells then harden, and form a firm coat for the spore within. As the plant decays in the autumn, these seed-like *sporocarps*, as they are now called, drop off and fall to the bottom of the water, where they eventually germinate. On germination, they first produce a simple form to which the name *pro-embryo* has been given, and from which arises the plant-body which bears the antheridia and carpogonia.

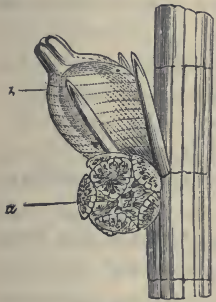

Fig. 255.

There is, therefore, displayed in this case an alternation of generations.

355. Chara belongs to a group of plants known as **Algæ.** They grow either in the water or upon damp surfaces. They differ from the Fungi principally in developing chlorophyll, so that they are able to assimilate. In colour, the Algæ are often green, but in other cases the chlorophyll is obscured by the presence of other colours, such as brown and red. In the lowest forms of both Algæ and Fungi reproduction takes place by simple division of the cells. In higher forms the entire contents of two similar adjacent cells coalesce to form a new one, from which the new plant springs. This is the process of conjugation (284). In still higher forms, as in Chara, reproduction takes place by fertilization.

Fig. 255.—Highly magnified view of part of the fertile thallus of Chara. (Thomé.)

356. The Algæ, Fungi, and Lichens together constitute a great group called **Thallophytes.** The Lichens from their peculiar constitution may be regarded as transitional between the Algæ and the Fungi, and by some the Charas are looked upon as links between the Algæ and the Bryophytes.

Some further reference will be made to the Thallophytes in the next chapter, in which is given a brief outline of the classification of plants generally.

CHAPTER XXIV.

CLASSIFICATION OF PLANTS ACCORDING TO THE NATURAL SYSTEM.

357. Hitherto our examination of plants has been confined to a few selected specimens, and we have examined these chiefly in order to become acquainted with some variations in the details of growth, as exemplified by them. Thus we have found plants which agree in exhibiting two cotyledons in the embryo, and others, again, which are monocotyledonous. Some members of the former group were found to exhibit two sets of floral envelopes, other only one, and others, again, were entirely without these organs. And so on through the various details. We now set out with the vegetable world before us—a world populated by forms almost infinite in number and variety. If, therefore, our study of these forms is to be carried on to advantage, we shall have to resolve upon some definite plan or system upon which to proceed; otherwise we shall merely dissipate our energies, and our results will be without meaning. Just as, in our study

of language, we find it convenient to classify words into what we call parts of speech, and to divide and sub-divide these again, in order to draw finer distinctions, so, in our study of plants, it will be necessary to arrange them first of all in comprehensive groups, on the ground of some characteristic possessed by every member of each group. Just as, in Latin, every noun whose genitive case is found to end in *æ* is classed with nouns of the first declension, so in Botany every plant presenting certain peculiarities will be placed in a group along with all the other plants presenting the same peculiarities.

358. Some hints have already been given you as to the kind of resemblances upon which classification is based. For instance, an immense number of plants are found to produce seeds with a dicotyledonous embryo, while an immense number of others have monocotyledonous embryos. This distinction, therefore, is so pronounced, that it forms the basis of a division into two very large groups. Again, a very large number of dicotyledonous plants have their corollas in separate petals; many others have them united, whilst others again have no petals at all. Here, then, is an opportunity to sub-divide the Dicotyledons into polypetalous, gamopetalous, and apetalous groups. And so we go on, always on the plan that the more widely spread a peculiarity is found to be, the more comprehensive must be the group based on that peculiarity; and so it happens, that the smallest groups of all come to depend upon distinctions which are, in many cases, by no means evident, and upon which botanists often find themselves unable to agree.

359. As our divisions and sub-divisions will necessarily be somewhat numerous, we shall have to devise a special

name for each kind of group, in order to avoid confusion of ideas. We shall, then, to begin with, draw a broad line of distinction between those plants which *produce flowers* of some kind, and those which *do not*, and to each of these great groups we shall give the name **Series.** We thus have the **Flowering,** or, to use the Greek term, **Phanerogamous, Series,** and the **Flowerless** or **Cryptogamous Series**; or we may speak of them briefly as **Phanerogams** and **Cryptogams.** Then, leaving the Cryptogams aside for the moment, we may break up the Phanerogams into two great **Classes, Dicotyledons** and **Monocotyledons,** for reasons already explained. By far the greater number of Dicotyledons produce seeds which are enclosed in a pericarp of some kind; but there is a remarkable group of plants (represented in Canada only by the Pines and their immediate relatives) which dispense with the pericarp altogether, and whose seeds are consequently naked. So that we can make two **Sub-classes** of the Dicotyledons on the basis of this difference, and these we shall call the **Angiospermous Sub-class** and the **Gymnospermous** (naked-seeded) **Sub-class.** The first of these may be grouped in three **Divisions,** the *Polypetalous*, *Gamopetalous*, and *Apetalous*, and the **Monocotyledons** also in three, the *Spadiceous*, the *Petaloideous*, and the *Glumaceous*, types of which we have already examined in the Marsh Calla (spadiceous), Trillium (petaloideous), and Timothy (glumaceous), and the distinctions between which are sufficiently obvious.

The **Cryptogams** are divided into three great **Classes,** viz.: **Pteridophytes,** embracing Ferns, Horsetails, and Club-mosses; **Bryophytes,** embracing

Mosses and Liverworts ; and **Thallophytes**, embracing Lichens, Seaweeds (Algæ), and Mushrooms (Fungi).

360. So far, then, our classification is as follows :

- VEGETABLE KINGDOM.
  - Series I. Phanerogams.
    - Class I.—Dicotyledons .. .. ..
      - Sub-class 1-Angiosperms.
        - *Polypetalous Division.*
        - *Gamopetalous do.*
        - *Apetalous do.*
      - Sub-class 2-Gymnosperms
    - Class II.—Monocotyledons .. ..
      - *Spadiceous Division.*
      - *Petaloideous do.*
      - *Glumaceous do.*
  - Series II. Cryptogams.
    - Class III.—Pteridophytes.
    - Class IV.—Bryophytes.
    - Class. V.--Thallophytes.

361. The above is very nearly the arrangement adopted by Gray, but many botanists prefer another arrangement as follows :

- VEGETABLE KINGDOM.
  - Group I. Phanerogams.
    - *A.*—Angiosperms.
      - Class I.—*Dicotyledons.*
      - Class II.—*Monocotyledons.*
    - *B.*—Gymnosperms.
      - Class III.—*Gymnosperms.*
  - Group II. Pteridophytes.
    - Class IV.—*Ferns.*
    - Class V.—*Horsetails.*
    - Class VI.—*Club-Mosses.*
  - Group III. Bryophytes.
    - Class VII.—*Mosses.*
    - Class VIII.—*Liverworts.*
  - Group IV. Thallophytes.
    - Class IX.—*Fungi.*
    - Class X.—*Algæ.*

In this arrangement the last three Groups constitute the Cryptogams, and the Gymnosperms are raised to the rank of a sub-division of the Phanerogams, instead of being a sub-division of the Dicotyledons. The Lichens, also, are included in the Fungi.

362. The whole question of botanical classification is still in an unsettled state. For further information in regard to the various modes that have been put forward, the student must consult larger works. In the second part of this book, whilst the classification of Gray (who follows Bentham and Hooker) is followed in a general way, those who prefer the second arrangement of the Phanerogams as given above may easily make the requisite change.

363. Each of the *Divisions* is sub-divided into a number of **Families** or **Orders**; each Order into a number of **Genera**; and each Genus into **Species.**

The names of the Orders as a rule have the ending *-aceæ*, as: *Ranunculaceæ, Rosaceæ.* These names are adjectives agreeing with the noun *Plantæ* understood, so that they mean "Rosaceous plants," "Ranunculaceous plants," &c.

364. A species is the sum of all the individual plants whose resemblances in all essential respects are so great as to warrant the belief that they have sprung from one common stock. De Candolle has this statement: "We unite under the designation of a *species* all those individuals that mutually bear to each other so close a resemblance as to allow of our supposing that they may have proceeded originally from a single being or a single pair." We may also speak of each one of these individual plants as a species. For example, you may say, after finishing the first lesson of this book, that you have examined *a species of Buttercup.* Mere differences of

colour or size are not sufficient to constitute different species. The Balsams of our gardens, for instance, are of various colours, and the plants vary greatly in size, yet they all belong to one species. These minor differences, which are mainly the result of care and cultivation, give rise to *varieties.* These are of great interest to the horticulturist, but the study of *species* is the great end and aim of the botanist.

365. Those Species which are considered to resemble each other most nearly are grouped into Genera, and the Genera, in like manner, into Orders; but these particular groupings are more or less artificial, and are subject to continual alteration in consequence of our imperfect knowledge. As year by year new facts are brought to light, modifications in arrangement take place. In the Classification of common plants which constitutes the Second Part of this work, the Divisions spoken of above are placed in the order named. In the Polypetalous Division, those Orders are put first which embrace plants with *hypogynous stamens* and *apocarpous pistils*, the parts of the flowers being consequently *separate;* then those with similarly inserted stamens, but *syncarpous pistils;* then those with *perigynous* stamens; and, generally, we proceed from plants whose flowers have all their parts separate to those exhibiting more or less *cohesion* and *adhesion*, and finally to those having one or more parts of the flower wanting.

366. In looking up the name of a plant, it will be your object to determine the *Genus* to which it belongs, and also the *Species.* The name of every plant consists of two parts: its Genus first, and then its Species. The name of

the Genus is a Latin noun, and that of the Species generally a Latin adjective agreeing with the noun. The Buttercup, for example, which we examined at the outset, belongs to the Genus *Ranunculus.* In this Genus are included many Species. The particular one examined by us is known as *acris;* so that the full name of the plant is *Ranunculus acris.* In like manner, the name of the plant popularly called Marsh-Marigold is *Caltha palustris.*

367. The *Key* which is prefixed to the Classification will enable you to determine without much difficulty the *Order* to which a plant belongs, but nothing more. Having satisfied yourselves as to the Order, you must turn to the page on which that Order is described, and, by carefully comparing the descriptions there given with the characters exhibited by your plant, decide upon its Genus, and, in the same manner, upon its Species.

THE HERBARIUM.

368. Those who are anxious to make the most of their botanical studies will find it of great advantage to gather and preserve specimens for reference. A few hints, therefore, on this subject will not be out of place. It will, of course, be an object to collectors to have their specimens exhibit as many of their natural characters as possible, so that, although dried and pressed, there will be no difficulty in recognizing them ; and to this end neatness and care are the first requisites.

Specimens should be collected when the plants are in flower, and, if possible, on a dry day, as the flowers are then in better condition than if wet. If the plant is small, the whole of it, root and all, should be taken up; if too large to be treated in this way, a flower and one or two of the leaves (radical as well as cauline, if these be different) may be gathered.

As many of your specimens will be collected at a distance from home, a close tin box, which may be slung over the shoulder by a strap, should be provided, in which the plants may be kept fresh, particularly if a few drops of water be sprinkled upon them. Perhaps a better way, however, is to carry a portfolio of convenient size—say 15 inches by 10 inches—made of two pieces of stout paste board or thin deal, and having a couple of straps with buckles for fastening it together. Between the covers should be placed sheets of blotting-paper or coarse wrapping-paper, as many as will allow the specimens to be separated by at least five or six sheets. The advantage of the portfolio is, that the plants may be placed between the sheets of blotting-paper and subjected to pressure by means of the straps as soon as they are gathered. If carried in a box, they should be transferred to paper as soon as possible. The specimens should be spread out with great care, and the crumpling and doubling of leaves guarded against. The only way to prevent moulding is to place plenty of paper between the plants, and *change the paper frequently;* the frequency depending on the amount of moisture contained in the specimens. From ten days to a fortnight will be found sufficient for the thorough drying of almost any plant you are likely to meet with. Having made a pile of specimens with paper between them, as directed, they should be placed on a table or floor, covered by a flat board, and subjected to pressure by placing weights on the top; twenty bricks or so will answer very well.

369. It is of great importance that *the sheet of paper within which the plant is first placed* should not be interfered with during the drying process. The directions as to frequent changes refer only to the sheets not immediately in contact with the plant. These, to ensure the best results, should be changed once a day for the first few days; less frequently thereafter. Gray recommends ironing with hot irons in order to remove more rapidly the moisture from fleshy leaves, and in any case to warm the driers in the sun before putting them between the plants.

When the specimens are thoroughly dry, the next thing is to mount them, and for this purpose you will require sheets of strong white paper; a good quality of unruled foolscap or cheap drawing paper will be suitable. The most convenient way of attaching the specimen to the paper is to take a sheet of the same size as your paper, lay the specimen carefully in the centre, wrong side up, and gum it thoroughly with a very soft brush. Then take the paper to which the plant is to be attached, and lay it carefully on the specimen. You can then lift paper and specimen together, and, by pressing lightly with a soft cloth, ensure complete adhesion. To render plants with stout stems additionally secure, make a slit with a penknife through the paper immediately underneath the stem; then pass a narrow band of paper round the stem, and thrust both ends of the band through the slit. The ends may then be gummed to the back of the sheet.

The specimen having been duly mounted, its botanical name should be written neatly in the lower right-hand corner, together with the date of its collection and the locality were found. Of course only one Species should be mounted on each sheet ; and when a sufficient number have been prepared, the Species of the same Genus should be placed in a sheet of larger and coarser paper than that on which the specimens are mounted, and the name of the Genus should be written outside on the lower corner. Then the Genera of the same Order should be collected in the same manner, and the name of the Order written outside as before. The Orders may then be arranged in accordance with the classification you may be using, and carefully laid away in a dry place. If a cabinet, with shelves or drawers, can be specially devoted to storing the plants, so much the better.

INDEX AND GLOSSARY.

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Fibro-vascular system, 287, 291, 295.
Filament, 6, 211.
Filiform, 183.
Fimbriate: fringed.
Fleshy fruits, 232.
Flora: a description of the plants of a district; a collective name for the whole of the species of a district.
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Floret, 61.
Flower: the part of a phanerogamous plant in which the stamens and pistil are situated.
Flower-head, 60.
Flower-leaves, 11.
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Foliaceous: like a leaf in appearance.
Foliage-leaves, 11, 156.
Foliolate: having leaflets.
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Free cell-formation, 283, 353.
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Fugacious: falling away early.
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Galea: an arching petal or sepal, as the two upper ones in Catnip, Fig. 59.
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Gamophyllous, 84.
Gamosepalous, 34, 205.
Gemmæ, 345.
Genera: plural of genus.
Genus, 363.
Germ: same as embryo.
Germ-cells, 347.
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Gibbous: swollen on one side.
Gills, 347.
Glabrous, 22, 182.
Gladiate: sword-shaped.
Glands: applied generally to cells or hairs on the surfaces of plants, in which resinous or oily matters are secreted; but the term is also used to describe any projection, the use of which is not clear, 226.
Glandular: bearing glands, 226.
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Globose: like a globe or sphere.
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Habitat: a term applied to the region most favourable to the growth of a plant: the place where it grows naturally.
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Heptandrous: with seven distinct stamens.

Organs of Vegetation: root, stem, and leaves.
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Orthotropous: applied to ovules when straight, so that the micropyle is as far as possible from the point of attachment, 246.
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Pappus: a circle of bristles or hairs representing the limb of the calyx in flowers of the Composite Family, 62.
Parallel-veined: same as straight-veined, 83.
Paraphyses, 353.
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Pentandrous: with five distinct stamens.
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Perennial: a plant which continues to grow year after year, 136.
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Phloem, 295.
Phosphorus, 307.
Phyllome, 225.
Phyllotaxis, 158.
Pileus, 347.
Pilose: having long, soft hairs.
Pinna: a primary division of a pinnately-compound leaf.
Pinnate, 168.
Pinnately-lobed, 176.
Pinnatifid, 176.
Pinnule: a secondary division of a pinnately-compound leaf.
Pistil, 7, 13, 215.
Pistillate: having a pistil, 68, 70.
Pitcher-shaped (leaf), Fig. 169.
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Plumose: feathery.
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Pod: a dehiscent fruit, 25.
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Pollinia: pollen-masses, Fig. 93.
Polyadelphous, 40, 212.
Polyandrous: with numerous distinct stamens, 6, 24.
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Polygamous: having perfect as well as imperfect flowers.
Polygamo-diœcious, 75.
Polypetalous: having separate petals, 5, 207.

APPENDIX.

Selections from Examination Papers.

UNIVERSITY OF TORONTO.

1. Define suckers, stolons, offsets, runners, tendrils, thorns, and prickles, describing their respective origins and uses, and giving examples of plants in which they occur.

2. What are the functions of leaves? Describe the different kinds of compound leaves.

3. What is meant by inflorescence? Describe the different kinds of flower-clusters, giving an example of each.

4. Mention and explain the terms applied to the various modes of insertion of stamens.

5. How are fruits classified? What are multiple or collective fruits? Give examples.

6. Relate the differences in structure between endogenous and exogenous stems. Describe their respective modes of growth.

7. What is the food of plants? how do they obtain it? and how do they make use of it?

8. Describe the component parts of a simple flower. How is reproduction effected?

9. Describe the anatomical structure of a leaf, and the formation and office of leaf-stomata.

10. Explain the consequences of flowering upon the health of a plant, and show how these effects are remedied in different climates. What practical bearing has this upon horticulture?

11. Trace the development of a carpel from a leaf. Describe the different forms assumed by placentæ in compound ovaries, and explain the origin of these variations.

12. Mention the principal modes in which pollen gains access to the stigma. What are hybrid plants, and how are they perpetuated?

13. Describe the anatomy of a leaf. What are stomata?

14. What is the placenta in a seed-vessel? Describe the different modes of placentation. Show how the varieties of placentation agree with the "altered-leaf theory" of the pistil.

15. Give the characters of the Compositæ. How is the order sub-divided? Describe the composite flower, and mention some of the common Canadian examples of this order.

16. Give the peculiarities of Endogens in seed-leaf, leaf, and stem. Sub-divide the class. Describe shortly the orders Araceæ and Gramineæ.

17. Describe the wall of a seed-vessel, and notice its varieties of form.

18. What is meant by the dehiscence of a capsule? Show the different modes in which pods dehisce, and give examples of each.

19. Give the characters and orders of Gymnospermous Exogens.

20. Give the characters of Ranunculaceæ. Describe shortly some of the principal plants of the order.

21. Give some account of the *special forms* which the leaves of plants assume.

22. What are stipules? What their size and shape?

23. What is meant by Imperfect, Incomplete, and Unsymmetrical flowers respectively?

24. Describe Papilionaceous and Labiate corollas.

25. Write notes on Abortive Organs, Gymnospermous Pistil, and Pollen Granule.

26. Distinguish between the essential and non-essential materials found in plants, and notice the non-essential.

27. What is vegetable growth? Illustrate by a reference to the pollen granule in its fertilization of the ovary.

28. What is an axil? What is the pappus?

29. What are the cotyledons? What is their function, and what their value in systematic Botany?

30. Distinguish between Epiphytes and Parasites. Describe their respective modes of growth, and give examples of each.

31. What is the difference between roots and subterranean branches? Define rhizoma, tuber, corm, and bulb, giving examples of each. How does a potato differ botanically from a sweet-potato?

32. Describe the calyx and corolla. What modifications of parts take place in double flowers?

33. What is a fruit in Botany? Explain the structure of an apple, grape, almond, strawberry, fig, and pine-apple.

34. What organs appear in the more perfect plants? In what two divisions are they comprised?

35. Weak climbing stems distinguished according to the mode in which they support themselves, the direction of their growth, the nature of their clasping organs.

36. Structure and parts of a leaf: What is most important in their study? Give the leading divisions, and mention what secondary distinctions are required in specific description?

37. Function of the flower: its origin: its essential and accessory parts: name of the circles and their component organs: circumstances which explain the differences among flowers.

38. Parts of the fully formed ovule and distinctions founded on their relative position.

39. Sub-kingdoms and classes of the vegetable kingdom.

40. What is meant by a composite flower? Illustrate your answer by reference to the dandelion, and point out in what respect its flower-head differs from that of the common clover.

41. Define what is meant by the terms *Exogen* and *Endogen*.

42. Explain what is meant by the following: Stamens and petals are, from a morphological point of view, leaves.

What is the morphological nature of onion bulbs, and potato tubers?

43. Name and describe the different parts of stamens and pistils. Why are these two sets of organs called the essential parts of a flower? State what is meant by a staminate flower, and what by a pistillate flower? How is fertilization accomplished in the case of the latter?

44. What is meant by the terms, *berry*, *drupe*, and *pome?* Why cannot a raspberry or a strawberry be termed a true *berry?*

45. Draw outlines of the following forms of leaves: ovate, deltoid, lanceolate, reniform, peltate, sagittate, hastate, cordate, obcordate.

46. Define the following terms: involucre, glume, gynœcium, micropyle, pappus, spadix, tendril, cyme.

SECOND AND THIRD CLASS TEACHERS' CERTIFICATES, PROVINCE OF ONTARIO.

1. Name the parts of the pistil and stamens of a flower and give their uses.

2. What are Perennial plants? Describe their mode of life.

3. "There are two great classes of stems, which differ in the way the woody part is arranged in the cellular tissue." Fully explain this.

4. Describe the functions of leaves. How are leaves classified as to their *veining*.

5. Name and describe the organic constituents of plants.

6. Name the organs of reproduction in plants, and describe their functions.

7. Give, and fully describe, the principal parts of the flower.

8. What are the different parts of a plant? Describe the functions of each part.

9. State all the ways by which an Exogenous stem may be distinguished from an Endogenous.

10. Describe the functions of leaves. What is the cause of their fall in autumn? Draw and describe a maple leaf.

11. Name the different parts of a flower, and describe the use of each part. Draw a diagram showing a stamen and a pistil and the parts of each.

12. What is the fruit? Why do some fruits fall from the stem more easily than others?

13. Of what does the food of plants consist? In what forms and by what organs is it taken up, and how is it assimilated? Name the substances inhaled and those exhaled by plants, and the uses of each in the economy of nature.

14. Describe fully (1) the plant in Vegetation; (2) the plant in Reproduction.

15. Describe Fibrous roots, Fleshy roots, and different kinds of Tap-root.

16. Describe the structure and veining of leaves.

17. "The nourishment which the mother plant provides in the seed is not always stored up in the embryo." Explain and illustrate.

18. Describe the various modes in which Perennials "provide a stock of nourishment to begin the new growth."

19. Describe fully the organs of reproduction in a plant. Describe the process of germination.

20. What are the parts of a flower? Give illustrations by diagram, with a full description.

21. Name and describe the principal sorts of flowers.

22. What elementary substances should the soil contain for the nourishment of plants?

23. How are plants nourished before and after appearing above ground?

24. Tell what you know about the various forms of the calyx and the corolla.

25. Explain the terms Cotyledon, Pinnate, Root-stock, Filament, and Radicle.

26. Explain the terms Papilionaceous, Cruciferous, Silique, and Syngenesious; and in each case name a family in the description of which the term under consideration may be properly applied.

27. Give the characters of the Rose family.

28. Describe the various modes in which biennials store up nourishment during their first season.

29. Explain the meaning of the terms Sepal, Bract, Raceme, and Stipule. Describe minutely the Stamen and the Pistil, and give the names applied to their parts.

30. Are the portions of the onion, the potato, and the turnip which are capable of preservation through the winter, equally entitled to the name of roots? Give reasons for your answer.

31. Describe briefly a vegetable cell in regard to its form, size, contents, &c.

What differences usually exist between cells found in pith and those found in wood?

32. Name two kinds of underground stems.

How do we know that they are not roots?

State any uses of these stems (*a*) to the plant, (*b*) to man.

33. What are the functions of the leaf in plant life?

State any differences between leaves which are surrounded by air and leaves which float upon water.

Give any laws according to which leaves are arranged upon the stem.

34. Give the names and relative positions of the parts of a complete flower.

Can you name a flower which is *perfect* but not *complete?*

35. When a pea is soaked in water it splits into two parts, united by a small ligament, but a grain of corn does not. Explain the meaning of this difference.

36. Is an apple a Botanical fruit? If not, what is it?

37. Name any plants belonging to the following natural orders:—Cruciferæ, Carophyllaceæ, Compositæ, Labiatæ.

38. From what does the root of an exogenous plant originate? What are the chief functions of roots? How may roots be distinguished from underground stems?

39. From what do stems originate? Compare in appearance transverse sections of the stem of an elm and of a stalk of maize. How do these stems differ in their modes of growth?

40. What are the functions of foliage-leaves? Describe briefly the general structure and appearance of the leaf of (*a*) the Sugar Maple (*Acer saccharinum*); (*b*) the Indian Turnip (*Arisæma triphyllum*).

41. Name the parts of a complete flower, and briefly describe the chief modifications due to cohesion, adhesion, and suppression of parts. (Name illustrative examples of each modification you describe.)

42. Contrast a strawberry, a raspberry, and an apple, and compare a gooseberry, a lemon, and a melon.

43. What are the general characters of the Cruciferæ, the Leguminosæ, the Liliaceæ, and the Gramineæ?

44. What are the morphological characters of roots? How do adventitious roots differ from normal roots as respects their origin? Briefly describe the normal mode of growth of the roots of Gymnosperms and Dicotyledons.

45. Describe briefly the structure of the stem of the Sunflower (*Helianthus annuus*). Mention the chief differences in the structure and the mode of growth of the bark in different dicotyledonous trees?

46. What is meant by an inflorescence? Distinguish between definite and indefinite inflorescence, and briefly describe the chief kinds of indefinite inflorescence, giving an example of each.

47. Describe the structure and the process of germination of the following named seeds: bean, buckwheat, marsh-marigold, oat.

48. What are stomata? On what plants and parts of plants are they found? What are their functions?

49. Give the distinguishing characters of the Sapindaceæ, the Rosaceæ, the Coniferæ, and the Iridaceæ. Name a Canadian plant belonging to each of these orders, and mention any uses made of it or of any part of it.

50. Define the following terms: bract, scale, involucre, spathe, scape, pedicel, asepalous, monœcious, monadelphous, perianth, stamen, pistil, pome, thallus, drupe.

51. Describe briefly the structure, the mode of growth, and the use to the plant of roots. Name an example of a plant with aërial roots.

52. Name the enveloping and the essential organs of the flower, and give a morphological comparison of foliage-leaves, floral envelopes, stamens, and carpels.

53. Describe briefly the general process of plant-nutrition, and name the essential elements in the food of plants.

54. Give the chief distinctive characters of the Cruciferæ, the Leguminosæ, the Umbelliferæ, and the Liliaceæ. Name three common examples of each of these families.

55. Describe the modes by which the fertilization of a flower is accomplished.

56. Distinguish between "definite" and "indefinite" inflorescence.

57. Which are the nutritive and which the reproductive organs of plants?

Briefly describe the principal ones of each kind.

58. Describe the structure of a "follicle," a "siliqua" and a "legume."

59. When is a flower said to be "complete," "regular," and "symmetrical?"

60. Fill the accompanying Floral Schedule with an accurate description of the specimen before you, referring it to its proper order, &c.

61. Distinguish between (the series): Phanerogams and Cryptogams. State their divisions and note the distinctions of those of the first (series).

62. What is the foundation of all vegetable tissue? and of its elements which is essential for its growth and development?

63. Describe the functions of the roots, stems, and foliage-leaves of plants. State the kinds and sources of their nourishment. Mention the changes the nutritive elements undergo in their passage through them and the agencies by which these changes are effected.

64. Name, describe, and give the functions of the several parts of a typical flower. State which are essential and why.

65. Give the general characteristics of the Leguminosæ, Rosaceæ and Coniferæ.

66. Refer to their botanical orders, genera, etc.: the plum, pear, orange, pumpkin, cucumber, carrot.

67. Describe the structure and mode of growth of exogenous and endogenous stems.

68. Give the meanings of apocarpous and syncarpous, and name two allied genera which may be distinguished by the difference these terms express.

69. Where, in plants, are stomata most abundant? What is their chief function? Describe chlorophyll and explain its physiological importance.

70. By what means is fertilization effected (1) in Phanerogams, and (2) in Cryptogams?

71. How would you distinguish a root from a stem? Enumerate the most important varieties of roots, giving examples.

72. Make a drawing of the leaf of the sugar maple (*Acer Saccharinum*) and of the beech (*Fagus ferruginea*), and describe them with special reference to form, parts, and venation.

73. Fill the accompanying Floral Schedule with an exact description of the specimen before you. Classify, if you can.

FIRST CLASS CERTIFICATES.

1. What are the cotyledons? Describe their functions, &c. State their value in systematic botany.

2. Describe the difference in structure and modes of growth of exogenous and endogenous stems.

3. Describe the circulation in plants. "In the act of making vegetable matter, plants purify the air for animals." Explain this fully.

4. What are Phænogamous plants? Define Raceme, Corymb, Head, Panicle, Ament.

5. Give the characters of (*a*) the classes Exogens and Endogens; (*b*) the Mint and Lily families.

6. To what family do the Cedar, Clover, Mustard, and Dandelion respectively belong?

7. Why does a botanist consider the tuber of the potato an underground stem.

8. Give the philosophical explanation of the nature of a flower considered as to the origin and correspondence of its different parts.

9. Draw a spathulate, an obcordate, a truncate, a palmately-divided and an odd-pinnate leaf.

10. Explain the constitution of a pome or apple-fruit.

11. What organs appear in the more perfect plants, and in what divisions are they comprised?

12. Give the function of the flower, its origin, and its essential and accessory parts.

13. Describe the nature and chief varieties of roots, and distinguish between them and underground stems.

14. "As to the Apex or Point leaves are Pointed, Acute, Obtuse, Truncate, Retuse, Emarginate, Obcordate, Cuspidate, Mucronate." Sketch these different forms.

15. "There is no separate set of vessels, and no open tubes for the sap to rise through in an unbroken stream, in the way people generally suppose." Comment on this passage.

16. The great series of Flowering Plants is divided into two *classes*. Describe these classes.

17. Give the cniet characteristics of the order *Cruciferæ* (Cress Family), and name some common examples of this order.

18. State the difference between definite and indefinite inflorescence, and give examples of the latter.

19. Of wnat does the food of plants consist? In what form is it found in the soil? How is it introduced into the plant? What inference may be drawn respecting the culture of the plant?

20. Distinguish weak climbing stems according to the mode in which they support themselves, the direction of their growth, and the nature of their clasping organs.

21. Name the three classes of Flowerless Plants, and give an example of each.

22. Explain the terms Spore, Capsule, Bract, Stipule, Albumen, and Epiphyte.

23. What are tendrils, and of what organs are they supposed to be modifications?

24. Give the characters of the Cress Family, and name as many plants belonging to it as you can.

25. Tell what you know about the minute structure and the chemical composition of vegetable tissue.

26. Describe the origin of the different kinds of placentas; and of the different parts of the fruit of the plum, the oak, and the maple.

27. Describe fully the process by which it is supposed that water is carried up from the roots of plants.

28. Give the meaning of the terms *stomate, indehiscent, thyrse, glume, pyxis.* Distinguish *epiphytes* from *parasites.*

29. Describe any plant you have examined; if you can, tabulate your description.

30. Name all the families of monopetalous dicotyledons which you remember, and give the characters of any one of them.

31. Describe the following: primordial cell (utricle), protoplasm, cyclosis, mode of plant growth.

32. Describe the process of reproduction in a phanerogamic plant.

33. How are the pulse family—order Leguminosæ—distinguished? Show the utility of the plants of this order.

34. What is Æstivation? Describe the different kinds, and mention a natural order of which each is characteristic.

35. Describe the course of the sap through the root and trunk of an exogenous tree.

36. Enumerate the chief nitrogenous and non-nitrogenous substances which are found in plants.

37. Fill in the accompanying Floral Schedule with a full and accurate description of the specimen under observation.

McGILL UNIVERSITY.

1. Describe the germination of a plant.

2. Explain the differences in the structure of the embryo.

3. Explain the functions of the Root.

4. Describe the structures in a leaf, and explain their action on the air.

5. Mention the several parts of the stamen and the pistil, and explain their uses.

6. Describe an Achene, a Samara, a Drupe, and a Silique.

7. Describe the differences in the stems of Exogens and Endogens, and the relations of these to the other parts of the plant and to classification.

8. Explain the terms Genera, Species, Order.

9. What is an excurrent stem, an axillary bud, bud scales?

10. Explain the terms *primordial utricle*, *parenchyma*, *protoplasm*, as used in Botany.

11. What are the functions of the nucleus in a living cell?

12. Explain the movements of the sap in plants.

13. Describe the appearance under the microscope of *raphides*, *spiral vessels*, and *disc-bearing wood-cells*.

14. Describe the structure of the bark of an Exogen.

15. Describe freely the anatomy of a leaf.

16. Describe shortly the parts and structures denoted by the following terms: *spine*, *aërial root*, *phyllodium*, *cambium*, *stipule*, *rhizoma*.

17. Give examples of *phænogams*, *cryptogams*, *exogens*, and *endogens*, properly arranged.

18. Describe the principal forms of indeterminate inflorescence.

19. In what natural families do we find *siliques*, *didynamous stamens*, *labiate corollas*, or *pappus-bearing achenes*. Describe these structures.

20. State the characters of any Canadian exogenous order, with examples.

21. Describe the cell-walls in a living parenchymatous cell.

22. Describe the fibro-vascular tissues in an Exogenous stem.

23. Describe the appearance of stomata and glandular hairs under the microscope.

24. Define *prosenchyma*, *corm*, *cyclosis*, *thallus*.

25. Explain the sources of the Carbon and Nitrogen of the plant, and the mode of their assimilation.

26. Describe the pericarp, stating its normal structure, and naming some of its modifications.

27. Explain the natural system in Botany, and state the gradation of groups from the species upward, with examples.

ONTARIO COLLEGE OF PHARMACY.

1. What do plants feed upon ?

2. What do you understand by the terms Acaulescent, Apetalous, Suffrutescent, Culm ?

3. Name some of the different forms of Primary, Secondary, and Aërial Roots, giving examples.

4. Explain the following terms descriptive of forms of leaves, giving sketch :— Ovate, Peltate, Crenate, Serrate, Cleft, Entire, Cuspidate, Perfoliate.

5. Explain difference between Determinate and Indeterminate inflorescence, giving three examples of each.

6. What organs are deficient in a sterile and a fertile flower ?

7. Give the parts of a perfect flower, with their relative position.

8. Give the difference between simple and compound Pistil, with examples of each.

9. Name the principal sorts of buds, and explain how the position of these affects the arrangement of branches.

10. Give description of multiple and primary roots, with two examples of same; also explain the difference between these and secondary roots.

11. Name the principal kinds of subterranean stems and branches, and explain how you would distinguish between these and roots.

12. In the classification of plants explain difference between classes and orders: genus and species.

13. Name three principal kinds of simple fruits.

14. When roots stop growing does the absorption of moisture increase or decrease ? Give reason for it.

15. Upon what do plants live ? Indicate how you would prove your answer correct.

16. In what part of the plant, and when, is the work of assimilation carried on ?

17. Name three principal kinds of *determinate*, and some of *indeterminate*, inflorescence ; name the essential organs of a flower.

18. In what respects do plants differ from inorganic matter ? And from animals ?

19. Describe a Rhizome, Tuber, Bulb ; and say if they belong to the root or stem. Which are Rheum, Jalapa, Sweet Potato, Onion ?

20. Define the difference between natural and special forms of leaves; between simple and compound leaves. Give example of each. Sketch a connate-perfoliate leaf.

21. Mention the parts of an embryo. Of a leaf. Of a pistil. Of a stamen. Of a seed.

22. What is meant by an albuminous seed? By diœcious flowers? By a compound ovary?

23. What is the difference between determinate and indeterminate inflorescence? How do they influence growth of the stem. Give three principal kinds of each.

24. Name the parts of a flower. What office is performed by the ovule? Name two kinds.

25. Name the parts of a vegetable cell. What are spiral ducts?

26. In what parts of the plant is the work of absorption carried on? In what part the work of assimilation? How do the plants purify the air for animals?

27. Explain the natural system of classification in Botany? Name and characterize the classes of plants.

28. Explain the structure and functions of the Leaf, Bud, Root.

29. Give some of the terms used in describing the shape of a simple leaf as concerns (*a*) its general contour, (*b*) its base, (*c*) its margin, (*d*) its apex.

30. Name the organs in a perfect flower; describe fully the structure of the anther and pollen. What is coalescence and adnation of the parts of a flower?

31. Explain the terms Raceme, Pappus, Coma, Rhizome, Pentastichous.

32. State the distinction between Exogens and Endogens.

33. What are cellular structures as distinguished from vascular? What is chlorophyll?

34. Mention tho organs of fructification, and explain the process of fertilization in a flowering plant.

35. Explain the structure of a seed, and describe in a few words the process of germination.

36. Define what is meant by the following terms: Morphology, Polycotyledonous, Epiphyte, Peduncle, Stipules.

37. Describe briefly the root, stem, leaf, and flower of the common dandelion, giving the functions or office of each.

38. Name some of the most common forms of leaves, giving a few rough outlines.

W. J. Gage & Co.'s Educational Series.

THE

COMMONLY OCCURRING

WILD PLANTS OF CANADA,

AND MORE ESPECIALLY OF

THE PROVINCE OF ONTARIO.

A FLORA FOR THE USE OF BEGINNERS.

BY

H. B. SPOTTON, M.A., F.L.S.,

PRIN. BARRIE COLL. INST.,

Author of "The Elements of Structural Botany."

REVISED EDITION.

W. J. GAGE & COMPANY,

TORONTO.

CONTENTS.

PREFACE TO THE FIRST EDITION.

A few words will not be out of place by way of preface to the List of Common Canadian Plants contained in the following pages. It will be observed that the List is confined to wild plants, the exclusion of cultivated Species having been determined on, partly because of the difficulty of knowing where to stop when an enumeration of them has once been entered upon, and partly because it was thought that, on the whole, more important results would be attained by directing attention exclusively to the denizens of our own woods and fields. What is really desired is, to create among our young people an interest in the Botany of Canada, and it seems not unreasonable to hope that this end may be better attained by placing within their reach some such handy volume as the present, dealing only with such plants as grow spontaneously within our limits.

The great majority of the plants described have been personally examined, and their occurrence verified, by the writer, his observations having been directed to what may fairly be regarded as representative districts of the older Provinces, but special acknowledgments are also due to Prof. Macoun, of the Geological Survey, for the free use of his valuable notes, and other friendly assistance.

Whilst diligence has been exercised that no commonly occurring plant should be omitted, yet it can hardly be that such omissions do not occur, and the writer will be most grateful to any observers into whose hands the List may come, if they will kindly draw his attention to any such defects, so that they may be remedied in subsequent editions.

The Classification and Nomenclature adopted are very nearly those of the Fifth Edition of Dr. Gray's Manual of the Botany of the Northern United States, and the writer most gratefully acknowledges the great assistance he has received from the admirable descriptions in that work.

Except in a very general way, no attempt has been made to define the limits of the range of the various Species, as observations tend to show that the range, in many cases, is undergoing constant alteration from various causes. When, however, a Species has appeared to be confined to a particular locality, mention has been made of that fact, but, as a rule, Species known to be of rare occurrence have been excluded.

Characters considered to be of special importance in the determination of the various Species have been emphasized by the use of italics, and where the Species of a Genus, or the Genera of an Order, are numerous, a system of grouping according to some prominent character has been adopted, so as to reduce the labour of determination as much as possible.

To assist the non-classical student, names which might be mispronounced have been divided and accentuated, the division having no reference whatever to the etymology of the words, but being simply based upon their sound when properly pronounced.

It need hardly be added that the writer's ELEMENTS OF STRUCTURAL BOTANY is designed to be the constant companion of the present Flora, in the hands of the young student, for the explanation of such technicalities as he may not have previously mastered.

BARRIE, November, 1883.

PREFACE TO THE REVISED EDITION.

The necessity of casting new plates has been taken advantage of to enlarge and otherwise improve the present List of Common Canadian Wild Plants. Descriptions of about one hundred and seventy additional species have been inserted, and one or two which had a place in the old list have, in the light of more thorough investigation, been struck out.

The principal authority for the additions is Macoun's Catalogue of Canadian Plants, issued by the Geological Survey, in which are included the results of the labours of many assiduous workers. The author has, however, also to thank his numerous correspondents in different parts of the country for their very valuable suggestions.

In the present Edition, it will be observed that the authorities for the names are given, and where these names differ from those in Macoun's Catalogue (which should be in the hands of every student), the synonym in the latter is also given.

BARRIE, February, 1889.

PRINCIPAL ABBREVIATIONS OF NAMES OF AUTHORS CITED IN THE FLORA.

Adans.	for	Adanson.
Ait.	"	Aiton.
Bart.	"	Barton.
Beauv.	"	Palisot de Beauvois.
Benth.	"	Bentham.
Bernh.	"	Bernhardi.
Bigel.	"	Bigelow.
Boiss.	"	Boissier.
Borkh.	"	Borkhausen.
Cass.	"	Cassini.
Cav.	"	Cavanilles.
DC.	"	De Candolle.
A. DC.	"	Alphonse De Candolle.
Desf.	"	Desfontaines.
Dill.	"	Dillenius.
Ell.	"	Elliott.
Endl.	"	Endlicher.
Engelm.	"	Engelmann.
Gært.	"	Gærtner.
Griseb.	"	Grisebach.
Gronov.	"	Gronovius.
Hoffm.	"	Hoffmann.
Hook.	"	W. J. Hooker.
H. B. K.	"	Humboldt, Bonpland, and Kunth.
Jacq.	"	Jacquin.
Juss.	"	Jussieu.
L.	"	Linnæus.
Lam.	for	Lamarck.
L'Her.	"	L'Heritier.
Lehm.	"	Lehmann.
Lindl.	"	Lindley.
Michx.	"	Michaux.
Mill.	"	Miller.
Muhl.	"	Muhlenberg.
Nees.	"	Nees von Esenbeck.
Nutt.	"	Nuttall.
Pers.	"	Persoon.
Poir.	"	Poiret.
R. Br.	"	Robert Brown.
Raf.	"	Rafinesque.
Rich.	"	Richard.
Richards.	"	Richardson.
Salisb.	"	Salisbury.
Schreb.	"	Schreber.
Scop.	"	Scopoli.
Spreng.	"	Sprengel.
Torr.	"	Torrey.
Tourn.	"	Tournefort.
Vaill.	"	Vaillant.
Vent.	"	Ventenat.
Vill.	"	Villars.
Wahl.	"	Wahlenberg.
Walt.	"	Walter.
Wangh.	"	Wangenheim.
Willd.	"	Willdenow.

HOW TO USE THE KEY AND THE FLORA.

Assuming that the student has carefully read the Introductory part of this work, and is familiar with the ordinary botanical terms, and the chief variations in plant-structure as there set forth, it should, with the aid of the accompanying Key, be a very simple task to refer to its proper Family any Canadian wild plant of common occurrence. To illustrate the method of using this Key, let us suppose that specimens of the following plants have been gathered, and that it is desired to ascertain their botanical names, that is, the name of the Genus and the Species of each :—Red Clover, Strawberry, Blue Flag, and Cat-tail Flag.

All of these produce flowers of some kind, and must therefore be looked for under the head of FLOWERING, OR PHANEROGAMOUS, PLANTS.

With the specimen of Red Clover in hand, and the book open at page xiii, we find that we have first to determine whether our plant is Dicotyledonous or not. The veining of the leaves suggests that it is so ; and this impression is confirmed by the fact that the parts of the flower are in fives. Then, is the plant an ANGIOSPERM ? As the seed will be found enclosed in an ovary, we answer—Yes. Has the plant both calyx and corolla ? Yes. Are the parts of the corolla separate ? Here a little doubt may arise ; but suppose we answer —*Yes.* Then our plant will be found somewhere in the POLYPETALOUS DIVISION. Proceeding with the enquiries suggested under this heading :—Are the stamens more than twice as many as the petals ? We find that they are not.

Turn, then, to the heading marked B, page xv, **"Stamens not more than twice as many as the petals."** Under this we find two subordinate headings, designated by asterisks * and **. The first of these is not applicable to our plant. Under the second, marked thus **, we find two minor headings, designated by daggers, +– and +–+–. The first of these, "*Corolla irregular*," is clearly the one we want. We have now, therefore, five Families to select from. We cannot choose any one of the first four, because our plant has ten stamens, but the characters of the fifth are precisely the characters exhibited by Clover. Our Clover, therefore, belongs to the Order LEGUMINOSÆ. Turning to page 33, and running through the "Synopsis of the Genera" as there given, we observe that No. 2, TRIFOLIUM, is the only Genus in which the flowers are in *heads.* Clover answers the description in the other respects also—viz.: "leaves of three leaflets," and "stamens diadelphous." The only question then remaining is, which Species of TRIFOLIUM have we in hand? Turning to page 34, we find we have six Species to choose from. No. 2, TRIFOLIUM *pratense*, is the only one of them with *purplish flowers.* TRIFOLIUM *pratense* must, consequently, be the botanical name we are looking for.

Possibly the observer may decide that the parts of the corolla are not separate from each other, because in some instances it is really a doubtful question. He must then turn to page xvii, and under II. GAMOPETALOUS DIVISION, he must pursue his inquiries as before. Is the calyx superior? Plainly not. Proceed then to the heading B, **"Calyx inferior."** Are the stamens more than the lobes of the corolla? Yes. Then the choice of the six Orders in the Section marked * is easily made as before, and the plant is referred to LEGUMINOSÆ.

Now let us take the Strawberry. As with Clover, we decide without difficulty that the plant is a DICOTYLEDON. The carpels are separate, and produce achenes in fruit; the plant must, therefore, be an ANGIOSPERM. And there is no doubt that it is Polypetalous. As the stamens are very numerous it must come under the section marked A. Under this section we have three subordinate headings, marked by one, two, and three asterisks, respectively. The stamens are clearly inserted on the calyx, and so our plant must be found under the heading marked **. Without hesitation, we refer it to the Order ROSACEÆ. Turning to page 38, we find fourteen Genera to select from. A very little consideration will show us that No. 8, FRAGARIA, is the Genus we must fix upon. Referring to page 43, we have to choose between two species, *Virginiana* and *vesca*, and the choice is found to depend upon such obvious characters as to furnish no difficulty.

The leaves of Blue Flag are straight-veined ; the parts of the flower, also, are in threes. We therefore decide that the plant is Monocotyledonous, and on turning to page xxii, we find three Divisions of Monocotyledons. The Flag clearly belongs to the PETALOIDEOUS DIVISION. Then, is the perianth superior or inferior ? Clearly the former. Next, are the flowers diœcious or perfect ? Clearly perfect. And as the flower has three stamens, it must belong to the Order IRIDACEÆ, described on page 155. The Genus is at once seen to be IRIS, and the Species is determined without difficulty.

The Cat-tail Flag is also manifestly Monocotyledonous, from the veining of the leaves. But it is not Petaloideous. The flowers are collected on a more or less fleshy axis at the top of a scape. It therefore belongs to the SPADICEOUS DIVISION, in which there are four Orders. The only practical question is, whether our plant belongs to ARACEÆ or TYPHACEÆ. On the whole, we choose the latter, and find our decision confirmed on reading the fuller account of the two Orders on pages 143 and 144. The Genus is immediately seen to be TYPHA, and the Species *latifolia*.

These examples need not be extended here ; but the beginner is recommended to run down, in the same manner, a few plants whose names he already knows. If successful in these attempts, he will naturally acquire confidence in his determinations of plants previously unknown to him.

KEY TO THE FAMILIES OR ORDERS

INCLUDED IN THIS WORK.

SERIES I. PHANEROGAMS.

Plants producing true flowers and seeds.

CLASS I. DICOTYLEDONS.

Distinguished ordinarily by having net-veined leaves, and the parts of the flowers in fours or fives, very rarely in sixes. Wood growing in rings, and surrounded by a true bark. Cotyledons of the embryo mostly two.

SUB-CLASS I. ANGIOSPERMS.

Seeds enclosed in an ovary.

I. POLYPETALOUS DIVISION.

Two distinct sets of Floral Envelopes. Parts of the corolla separate from each other.

A. Stamens more than twice as many as the petals.

* *Stamens hypogynous (inserted on the receptacle).*

+ *Pistil apocarpous (carpels separate from each other).*

RANUNCULACEÆ.—Herbs. Leaves generally decompound or much dissected.............................. 2

ANONACEÆ.—Small trees. Leaves entire. Petals 6, in 2 sets.. 7

MAGNOLIACEÆ—Trees. Leaves truncate. Fruit resembling a cone.. 6

MENISPERMACEÆ.—Woody twiners. Flowers diœcious. Leaves peltate near the edge.................... 7

Brasenia, in

NYMPHÆACEÆ.—Aquatic. Leaves oval, peltate; the petiole attached to the centre...................... 9

MALVACEÆ.—Stamens monadelphous. Calyx persistent. Ovaries in a ring.................................. 24

Podophyllum, in

BERBERIDACEÆ.—Calyx fugacious. Leaves large, peltate, deeply lobed. Fruit a large fleshy berry, 1-celled. 8

++ *Pistil syncarpous. (Stigmas, styles, placentæ, or cells, more than one.)*

Actæa, in

RANUNCULACEÆ, might be looked for here. Fruit a many-seeded berry. Leaves compound.......... 2

NYMPHÆACEÆ.—Aquatics. Leaves floating, large, deeply cordate.. 9

SARRACENIACEÆ.—Bog-plants. Leaves pitcher-shaped.... 10

PAPAVERACEÆ.—Juice red or yellow. Sepals 2, caducous. 10

CAPPARIDACEÆ.—Corolla cruciform, but pod 1-celled. Leaves of 3 leaflets............................ 16

HYPERICACEÆ. — Leaves transparent - dotted. Stamens usually in 3, but sometimes in 5, clusters......... 19

CISTACEÆ.—Sepals 5, very unequal, or only 3. Ovary 1-celled, with 3 parietal placentæ................. 18

MALVACEÆ.—Stamens monadelphous, connected with the bottom of the petals. Calyx persistent. Ovaries in a ring.. 24

TILIACEÆ.—Trees. Flowers yellowish, in small hanging cymes, the peduncle with a leaf-like bract attached.. 25

* * *Stamens perigynous (inserted on the calyx).*

Portulaca, in

PORTULACACEÆ.—Low herbs, with fleshy leaves. Sepals 2, adhering to the ovary beneath. Pod opening by a lid.. 23

ROSACEÆ.—Leaves alternate, with stipules. Fruit apocarpous, or a drupe, or a pome................. 38

* * * *Stamens epigynous (attached to the ovary).*

Nymphæa, in

NYMPHÆACEÆ.—Aquatic. Leaves floating. Flowers white, large, with numerous petals gradually passing into stamens........................... 9

B. Stamens not more than twice as many as the petals.

* *Stamens just as many as the petals, and one stamen in front of each petal.*

BERBERIDACEÆ.—Herbs (with us). Anthers opening by uplifting valves 8

PORTULACACEÆ.—Sepals 2. Styles 3-cleft. Leaves 2, fleshy 23

VITACEÆ.—Shrubs, climbing by tendrils. Calyx minute. 29

RHAMNACEÆ.—Shrubs, not climbing 29

Lysimachia, in

PRIMULACEÆ, is occasionally polypetalous. Flowers yellow, in axillary spikes; the petals sprinkled with purplish dots 91

* * *Stamens either just as many as the petals and alternate with em, or not of exactly the same number.*

+ *Corolla irregular.*

FUMARIACEÆ.—Corolla flattened and closed. Stamens 6. 11

VIOLACEÆ.—Corolla 1-spurred. Stamens 5. Pod with 3 rows of seeds on the walls 17

BALSAMINACEÆ.—Corolla 1-spurred, the spur with a tail. Stamens 5. Pod bursting elastically 27

POLYGALACEÆ.—Lower petal keel-shaped, usually fringed at the top. Anthers 6 or 8, 1-celled, opening at the top. Pod 2-celled 32

LEGUMINOSÆ.—Corolla mostly papilionaceous. Filaments often united. Ovary simple, with one parietal placenta. Leaves compound 33

+ + *Corolla regular, or nearly so.*

1. Calyx superior (*i.e.*, adherent to the ovary, wholly or partially).

(*a*) *Stamens perigynous* (*inserted on the calyx*).

Cratægus, in

ROSACEÆ.—Shrubs. Stamens occasionally from 5 to 10 only. Leaves alternate, with stipules. Fruit drupe-like, containing 1–5 bony nutlets 38

SAXIFRAGACEÆ.—Leaves opposite or alternate, without stipules. Styles or stigmas 2; in one instance 4. Ovary 1-celled, with 2 or 3 parietal placentæ 46

CARYOPHYLLACEÆ.—Styles 2–5. Ovules in the centre or bottom of the cell. Stem usually swollen at the joints. Leaves opposite........................ 21

LINACEÆ.—Stamens 5, united below. Pod 10-celled, 10-seeded.. 25

GERANIACEÆ.—Stamens 5. Carpels 5,—they and the lower parts of the 5 styles attached to a long beak, and curling upwards in fruit......................... 26

OXALIDACEÆ.—Stamens 10. Pod 5-celled. Styles 5, distinct. Leaflets 3, obcordate, drooping at night-fall. 27

ERICACEÆ.—Anthers opening by pores at the top, or across the top. Leaves mostly evergreen, sometimes brown beneath; but in some instances the plant is white or tawny...................................... 85

(*b*) *Stamens perigynous* (*plainly attached to the calyx*).

SAXIFRAGACEÆ.—Leaves opposite or alternate, without stipules. Styles or stigmas 2; in one instance 4. Carpels fewer than the petals................... 46

CRASSULACEÆ.—Flowers *symmetrical*. Stamens 10 or 8. Leaves sometimes fleshy........................ 48

LYTHRACEÆ.—Stamens 10, in two sets. Calyx enclosing, but really free from, the ovary. Leaves mostly whorled.. 51

(*c*) *Stamens attached to a fleshy disk in the bottom of the calyx-tube.*

ANACARDIACEÆ.—Trees, or shrubs, not prickly. Leaves compound. Stigmas 3. Fruit a 1-seeded drupelet. 28

CELASTRACEÆ.—Twining shrub. Leaves simple. Pods orange when ripe....................................... 30

SAPINDACEÆ.—Shrubs, or trees. Fruit 2-winged, and leaves palmately-veined. *Or*, Fruit an inflated 3-celled pod, and leaves of 3 leaflets. Styles 2 or 3....... 31

(*d*) *Stamens attached to the petals at their very base.*

Claytonia, in

PORTULACACEÆ.—Sepals 2. Leaves fleshy. Style 3-cleft. 23

AQUIFOLIACEÆ.—Shrubs, with small axillary flowers, having the parts in fours or sixes. Fruit a red berry-like drupe. Stigma sessile. Calyx minute....... 90

II. GAMOPETALOUS DIVISION.

Corolla with the petals united together, in however slight a degree.

A. Calyx superior (adherent to the ovary).

** Stamens united by their anthers.*

** * Stamens not united together in any way.*

+ Stamens inserted on the corolla.

+ + Stamens not inserted on the corolla.

B. Calyx inferior (free from the ovary).

** Stamens more than the lobes of the corolla.*

Adlumia, in

* * *Stamens just as many as the lobes of the corolla, one in front of each lobe.*

PRIMULACEÆ.—Stamens on the corolla. Ovary 1-celled, with a free central placenta rising from the base. 91

* * * *Stamens just as many as the lobes of the corolla, inserted on its tube alternately with its lobes.*

+ *Ovaries 2, separate.*

APOCYNACEÆ.—Plants with milky juice. Anthers converging round the stigmas, but not adherent to them. Filaments distinct.......................... 114

ASCLEPIADACEÆ.—Plants with milky juice. Anthers adhering to the stigmas. Filaments monadelphous. Flowers in umbels.......................... 114

+ + *Ovary 4-lobed aruond the base of the style.*

Mentha, in

LABIATÆ.—Stamens 4. Leaves opposite, aromatic........ 100

BORRAGINACEÆ.—Stamens 5. Leaves alternate.......... 105

+ + + *Ovary 1-celled; the seeds on the walls.*

HYDROPHYLLACEÆ.—Stamens 5, usually exserted. Style 2-cleft. Leaves lobed and sometimes cut-toothed. 108

GENTIANACEÆ.—Leaves entire and opposite; or (in Menyanthes) of 3 leaflets. 112

+ + + + *Ovary with 2 or more cells.*

AQUIFOLIACEÆ.—Shrubs. Corolla almost polypetalous. Calyx minute. Fruit a red berry-like drupe. Parts of the flower chiefly in fours or sixes........ 90

PLANTAGINACEÆ.—Stamens 4. Pod 2-celled. Flowers in a close spike.............................. 91

Verbascum, in

SCROPHULARIACEÆ.—Corolla nearly regular. Flowers in a long terminal spike. Stamens 5; the filaments, or some of them, woolly........................ 94

POLEMONIACEÆ.—Style 3-cleft. Corolla salver-shaped, with a long tube. Pod 3-celled, few-seeded; seeds small.. 109

CONVOLVULACEÆ.—Style 2-cleft. Pod 2-celled, generally 4-seeded; seeds large. Chiefly twining or trailing plants.. 109

* * * * *Stamens fewer than the lobes of the corolla; the corolla mostly irregular or 2-lipped.*

III. APETALOUS DIVISION.

Corolla (and sometimes calyx also) wanting.

A. Flowers not in catkins.

* *Calyx and corolla both wanting.*

* * *Calyx superior (i.e., adherent to the ovary).*

ELÆAGNACEÆ.—Shrubs with scurfy leaves. Flowers diœcious. Calyx 4-parted, in the fertile flowers apparently adherent to the ovary, and becoming fleshy in fruit.. 123

* * * *Calyx inferior (plainly free from the ovary).*

+ *Ovaries more than one and separate from each other.*

RANUNCULACEÆ.—Calyx present, coloured and petal-like. Achenes containing several seeds, or only one..... 2

RUTACEÆ.—Prickly shrubs, with compound transparent-dotted leaves, and diœcious flowers.............. 27

++ *Ovary only one, but with more than one cell.*

CRASSULACEÆ.—Herbs, in wet places. Pod 5-celled and 5-horned.. 48

PHYTOLACCACEÆ.—Herbs. Ovary 10-celled and 10-seeded. 116

EUPHORBIACEÆ.—Herbs. Ovary 3-celled, 3-lobed, protruded on a long pedicel. Juice milky.......... 125

SAPINDACEÆ.—Trees. Ovary 2-celled and 2-lobed. Fruit two 1-seeded samaras joined together. Flowers polygamous.................................. 31

RHAMNACEÆ.—Shrubs. Ovary 3-celled and 3-seeded; forming a berry.................................. 29

FICOIDEÆ.—Prostrate herbs with whorled leaves. Ovary 3-celled, many-seeded 52

URTICACEÆ.—Trees. Leaves simple. Ovary 2-celled, but fruit a 1-seeded samara winged all round. Stigmas 2.. 127

+++ *Ovary only one, 1-celled and 1-seeded.*

POLYGONACEÆ.—Herbs. Stipules sheathing the stem at the nodes.. 119

URTICACEÆ.—Herbs. Stigma 1. Flowers monœcious or diœcious, in spikes or racemes. No chaff-like bracts among the flowers. *Or*, Stigmas 2; leaves palmately-compound.................................. 127

AMARANTACEÆ.—Herbs. Flowers greenish or reddish, in spikes, *with chaff-like bracts interspersed.* Stigmas 2. 118

CHENOPODIACEÆ.—Herbs. Flowers greenish, in spikes. *No chaff-like bracts.* Stigmas 2................. 116

OLEACEÆ.—Trees. *Leaves pinnately-compound.* Fruit a 1-seeded samara.................................. 115

URTICACEÆ.—Trees. *Leaves simple.* Fruit a 1-seeded samara winged all round, or a drupe 127

LAURACEÆ.—Trees or shrubs. Flowers diœcious. Sepals 6, petal-like. Stamens 9, opening by uplifting valves. 122

THYMELEACEÆ.—Shrubs with leather-like bark, and jointed branchlets. Flowers perfect, preceding the leaves. Style thread-like...... 123

B. Flowers in catkins.

* *Sterile or staminate flowers only in catkins.*

JUGLANDACEÆ.—Trees with pinnate leaves. Fruit a nut with a husk.................................. 130

CUPULIFERÆ.—Trees with simple leaves. Fruit one or more nuts surrounded by an involucre which forms a scaly cup or bur....................... 131

* * *Both sterile and fertile flowers in catkins, or catkin-like heads.*

SALICACEÆ.—Shrubs or low trees. Ovary 1-celled, many-seeded; seeds tufted with down at one end....... 136

PLATANACEÆ.—Large trees. *Stipules sheathing the branchlets.* The flowers in heads....... 130

MYRICACEÆ.—Shrubs with resinous-dotted, usually fragrant, leaves. Fertile flowers one under each scale. Nutlets usually coated with waxy grains... 134

BETULACEÆ.—Trees or shrubs. Fertile flowers 2 or 3 under each scale of the catkin. Stigmas 2, long and slender.......... 135

SUB-CLASS II. GYMNOSPERMS.

Ovules and seeds naked, on the inner face of an open scale; or, in Taxus, without any scale, but surrounded by a ring-like disk which becomes red and berry-like in fruit.

CONIFERÆ.—Trees or shrubs, with resinous juice, and mostly awl-shaped or needle-shaped leaves. Fruit a cone, or occasionally berry-like................ 139

CLASS II. MONOCOTYLEDONS.

Distinguished ordinarily by having straight-veined leaves (though occasionally net-veined ones), and the parts of the flowers in threes, never in fives. Wood never forming rings, but interspersed in separate bundles throughout the stem. Cotyledon only 1.

I. SPADICEOUS DIVISION.

Flowers collected on a spadix, with or without a spathe or sheathing bract. Leaves sometimes net-veined.

II. PETALOIDEOUS DIVISION.

Flowers not collected on a spadix, furnished with a corolla-like, or occasionally herbaceous, perianth.

A. Perianth superior (adherent to the ovary).

* *Flowers diœcious or polygamous, regular.*

* * *Flowers perfect.*

B. Perianth inferior (free from the ovary).

Triglochin, in

ALISMACEÆ.—Rush-like marsh herbs. Flowers in a spike or raceme. Carpels when ripe splitting away from a persistent axis. 147

LILIACEÆ.—Perianth of similar divisions or lobes, mostly 6, but in one case 4. One stamen in front of each division, the stamens similar. 158

Trillium, in

LILIACEÆ.—Perianth of 3 green sepals and three coloured petals 158

PONTEDERIACEÆ.—Stamens 6, 3 long and 3 short. Perianth (blue or yellow) tubular, of 6 lobes. Aquatics. . . . 164

JUNCACEÆ.—Perianth glumaceous, of similar pieces. 162

ERIOCAULONACEÆ.—In shallow water. Flowers in a small woolly head, at the summit of a 7-angled scape. Leaves in a tuft at the base. 165

III. GLUMACEOUS DIVISION.

Flowers without a true perianth, but subtended by thin scales called glumes.

CYPERACEÆ.—Sheaths of the leaves not split. 165

GRAMINEÆ.—Sheaths of the leaves split on the side away from the blade 168

SERIES II. CRYPTOGAMS.

Plants without stamens and pistils, reproducing themselves by spores instead of seeds.

CLASS III. PTERIDOPHYTES.

Stems containing vascular as well as cellular tissue.

FILICES.—Spores produced on the fronds. 174

EQUISETACEÆ.—Spores produced on the under side of the shield-shaped scales of a terminal spike or cone. . . 181

LYCOPODIACEÆ.—Spore-cases produced in the axils of the simple leaves or bracts. 182

THE COMMONLY OCCURRING

WILD PLANTS OF CANADA,

AND MORE ESPECIALLY THOSE OF ONTARIO.

SERIES I.

FLOWERING OR PHANEROG'AMOUS PLANTS.

Plants producing Flowers (that is to say, Stamens and Pistils, and usually Floral Envelopes of some kind), and Seeds containing an Embryo.

Class I. DICOTYLE'DONS.

(See Sections 78–81, Part I., for characters of Class.)

Sub-class I. AN'GIOSPERMS.

Seeds enclosed in a pericarp.

I. POLYPET'ALOUS DIVISION.

Plants with flowers having both calyx and corolla, the latter consisting of petals entirely separate from each other. (In some genera and species, however, petals are absent.)

ORDER I. RANUNCULA'CEÆ. (CROWFOOT FAMILY.)

Herbs or woody climbers, with an acrid colourless juice. Parts of the flower separate from each other. Corolla sometimes wanting. Stamens numerous. Pistil (with one or two exceptions) apocarpous. Fruit an achene, follicle, or berry. Leaves exstipulate, with the blades usually dissected, and petioles spreading at the base.

Synopsis of the Genera.

1. **Clem'atis.** Real petals none or stamen-like. Coloured sepals 4 or more, valvate in the bud. Fruit an achene, with the long and feathery style attached. Leaves all opposite. Plant climbing by the bending of the petioles.
2. **Anemo'ne.** Petals none or stamen-like. Coloured (white) sepals imbricated in the bud. Achenes many, in a head, pointed or tailed, not ribbed. Stem-leaves opposite or whorled, *forming an involucre remote from the flower.*
3. **Hepat'ica.** Petals none. Coloured sepals 6–9, whitish or bluish. Achenes many, not ribbed. Leaves all radical. *An involucre of 3 leaves close to the flower,* and liable to be mistaken for a calyx.
4. **Thalic'trum.** Petals none. Coloured sepals 4 or more, greenish. Achenes several, angled or grooved. No involucre. Stem-leaves alternate, decompound. Flowers in panicles or corymbs, mostly diœcious.
5. **Ranun'culus.** Sepals 5, deciduous. Petals generally 5, each with a pit or little scale on the inside of the claw. Achenes many, in heads, short-pointed. Stem-leaves alternate. Flowers solitary or corymbed, mostly yellow, rarely white.
6. **Cal'tha.** Petals none. Sepals 5–9, yellow. Fruit a many-seeded follicle. Leaves large, glabrous, heart-shaped or kidney-shaped, mostly crenate. Stem hollow and furrowed.
7. **Cop'tis.** Sepals 5–7, white, deciduous. Petals 5–7, yellow, with slender claws, and somewhat tubular at the apex. Carpels 3–7, on slender stalks. Fruit a follicle. Flowers on naked scapes. Leaves radical, shining, divided into three wedge-shaped leaflets, sharply toothed. Root fibrous, golden yellow.
8. **Aquile'gia.** Sepals 5, coloured. Petals 5, *each a long hollow spur.* Carpels 5. Follicles erect, many-seeded. Flowers very showy, terminating the branches. Leaves decompound.
9. **Actæ'a.** Sepals 4–5, caducous. Petals 4–10, with slender claws. Stamens many, with long filaments. *Fruit a many-seeded berry.* Flowers in a short thick raceme. Leaves decompound, leaflets sharply toothed.
10. **Cimicif'uga.** Sepals 4–5, caducous. Petals several, small, two-horned at the apex. Carpels 1–8, becoming pods. Flowers in long plume-like racemes.

11. **Hydras'tis.** Petals none. Flower solitary. Sepals 3, petal-like, greenish-white. Carpels 12 or more, forming a head of crimson 1–2-seeded berries in fruit. Stem low, from a knotted yellow root-stock. Leaves simple, lobed.

1. CLEM'ATIS, L. VIRGIN'S BOWER.

C. Virginia'na, L. (COMMON VIRGIN'S BOWER.) A woody-stemmed climber. Flowers in panicled clusters, often diœcious, white. Leaves of 3 ovate leaflets, which are cut or lobed. Feathery tails of the achenes very conspicuous in the autumn.—Along streams and in swamps.

2. ANEMO'NE, L. ANEM'ONE.

1. **A. cylin'drica,** Gray. (LONG-FRUITED A.) Carpels very numerous, in an oblong woolly head about an inch long. Peduncles 2–6, long, upright, leafless. Stem-leaves in a whorl, twice or thrice as many as the peduncles, *long-petioled.* Sepals 5, greenish-white. Plant about two feet high, clothed with silky hairs.—Dry woods.

2. **A. Virginia'na,** L. (VIRGINIAN A.) Very much like the last, but larger. Also, the central peduncle only is naked, the others having each a pair of leaves about the middle, from whose axils other peduncles occasionally spring. Sepals greenish. Head of carpels oval or oblong.—Dry rocky woods and river-banks.

3. **A. Pennsylva'nica,** L. (*A. dichotoma, L.,* in Macoun's Catalogue.) (PENNSYLVANIAN A.) Carpels fewer and the head not woolly, but pubescent and spherical. *Stem-leaves sessile,* primary ones 3 in a whorl, but only a pair of smaller ones on each side of the flowering branches. Radical leaves 5–7-parted. Sepals 5, obovate, large and white. Plant hairy, scarcely a foot high.—Low meadows.

4. **A. nemoro'sa,** L. (WOOD A. WIND-FLOWER.) Plant not more than six inches high, nearly smooth, one-flowered. Stem-leaves in a whorl of 3, long-petioled, 3–5-parted. Sepals 4–7, oval, white, or often purplish on the back.—Moist places.

3. HEPAT'ICA, Dill. LIVER-LEAF. HEPATICA.

1. **H. acutil'oba,** DC. (SHARP-LOBED H.) Leaves with 3 (sometimes 5) acute lobes, appearing after the flowers. Petioles silky-hairy.—Woods in spring.

2. **H. tril'oba**, Chaix. (ROUND-LOBED H.) Leaves with 3 rounded lobes; those of the involucre also obtuse.—Dry rich woods in spring.

(The two species just described are included under ANEMONE in Macoun's Catalogue, the first named being *A. acutiloba, Lawson*, and the second *A. Hepatica, L.*)

4. THALIC'TRUM, Tourn. MEADOW-RUE.

1. **T. anemonoi'des**, Michx. (RUE-ANEMONE.) Stem low. Stem-leaves all in a whorl at the top. Roots tuberous. *Flowers several in an umbel*, by which character this plant is easily distinguished from Wood Anemone, which it otherwise resembles. —South-westward, in spring.

2. **T. dioi'cum**, L. (EARLY M.) Stem smooth, pale and glaucous, 1–2 feet high. *Flowers diœcious*, in ample panicles, purplish or greenish; the yellow anthers drooping and very conspicuous. Leaves alternate, decompound; leaflets with 5–7 rounded lobes.—Woods.

3. **T. Cornu'ti**, L. (TALL M.) Stem smooth or nearly so, 2–6 feet high. *Leaves sessile;* leaflets very much like No. 2. Flowers white, in compound panicles; *anthers not drooping;* filaments club-shaped.—Low wet meadows, and along streams.

5. RANUN'CULUS, L. CROWFOOT. BUTTERCUP.

1. **R. aquat'ilis**, L. (WHITE WATER-CROWFOOT.) *Foliage under water*, filiform. *Flowers white*, floating, each petal with a little pit on the inside of the claw. (Of this species there are several varieties; var. **trichopyllus**, Chaix, is the one here described, being the form commonly met with in Ontario and the eastern provinces.)

2. **R. multif'idus**, Pursh. (YELLOW WATER-CROWFOOT.) Like No. 1, but larger, and with *yellow flowers.*—Ponds and ditches.

3. **R. Flam'mula**, L., var. **reptans**, Meyer. (CREEPING SPEARWORT.) Stem reclining, rooting at the joints, *only 3–6 inches long*. Leaves linear, entire, remote. Flowers yellow, ¼ of an inch broad.—Sandy and gravelly shores of ponds and rivers.

4. **R. aborti'vus,** L. (SMALL-FLOWERED C.) Petals shorter than the reflexed calyx. Stem erect, *very smooth,* slender. Radical leaves roundish, crenate, petiolate; stem-leaves 3–5-parted, sessile. Carpels in a globular head, each with a minute curved beak.—Shady hill-sides and wet pastures.

5. **R. scelera'tus,** L. (CURSED C.) Petals about the same length as the calyx. Stem thick, hollow, *smooth.* Radical leaves 3-lobed; stem-leaves 3-parted, uppermost almost sessile. *Head of carpels oblong.*—Wet ditches.

6. **R. recurva'tus,** Poir. (HOOKED C.) Petals shorter than the reflexed calyx. *Stem hirsute,* with stiff spreading hairs. Radical and cauline leaves about alike, long-petioled. Head of carpels globular, *each with a long recurved beak.*—Woods.

7. **R. Pennsylva'nicus,** L. (BRISTLY C.) Petals not longer than the calyx. *Stem hirsute.* Leaves ternately divided, divisions of the leaves stalked, unequally 3-cleft. *Head of carpels oblong, with straight beaks,* and so easily distinguished from No. 6.—Wet places.

8. **R. re'pens,** L. (CREEPING C.) Petals much longer than the calyx. Early-flowering stems ascending, *putting forth long runners during the summer.* Leaves ternate, divisions generally stalked, petioles hairy. Peduncles furrowed.—Wet places.

9. **R. bulbo'sus,** L. (BULBOUS C. BUTTERCUP.) Petals much longer than the calyx. Stem erect, *from a bulb-like base.* Flowers an inch broad, on *furrowed peduncles.*—Pastures. Rather rare.

10. **R. a'cris,** L. (TALL C. BUTTERCUP.) Much taller than No. 9. Petals much longer than the calyx. Stem upright, *no bulb at the base.* Peduncles *not furrowed.*

11. **R. fascicula'ris,** Muhl. (EARLY C.) Petals much longer than the calyx. Plant 5–9 inches high, erect, pubescent with silky hairs. Radical leaves appearing pinnate, the terminal division long-stalked, the lateral ones sessile. *Root a bundle of thickened fleshy fibres.*—Rocky woods and fields in spring.

6. CAL'THA, L. MARSH-MARIGOLD.

C. palustris, L. (MARSH-MARIGOLD.) Stem about a foot high, hollow, round, forking, very glabrous. Flowers golden yellow, 1–1½ inches broad.—Swamps and wet meadows. A very conspicuous plant in early spring.

7. COP'TIS, Salisb. GOLDTHREAD.

C. trifolia, Salisb. (THREE-LEAVED GOLDTHREAD.) Low and stemless. Scapes 1-flowered, with a single bract above the middle. Petals much smaller than the sepals.—On logs and about stumps in cedar-swamps.

8. AQUILE'GIA, Tourn. COLUMBINE.

-94 **A. Canadensis,** L. (WILD COLUMBINE.) Stem branching, a foot or more in height, smooth. Leaves decompound; leaflets in threes. Flowers nodding, scarlet outside, yellow within. — Rocky woods and thickets.

9. ACTÆ'A, L. BANEBERRY.

1. **A. spica'ta,** L., var. **rubra,** Michx. (RED B.) *Raceme short,* breadth and length being about the same. Pedicels slender. *Berries red.*—Rich woods.

2. **A. alba,** Bigel. (WHITE B.) *Raceme longer than broad.* Pedicels thickened in fruit, cherry-coloured. *Berries white.*—Same localities as No. 1.

10. CIMICIF'UGA, L. BUGBANE.

C. racemo'sa, Ell. (BLACK SNAKEROOT.) Stem 3–6 feet high. Resembling a tall Actæa, but easily distinguished by its plume-like raceme of white flowers.—Along Lake Erie.

11. HYDRAS'TIS, L. ORANGEROOT. YELLOW PUCCOON.

H. Canadensis, L. A low plant, bearing a single radical leaf, and a pair of cauline ones near the summit of the simple stem. Leaves rounded, cordate, 5–7-lobed, very large when fully grown.—Wet meadows, in early summer, south-westward.

ORDER II. MAGNOLIA'CEÆ. (MAGNOLIA FAMILY.)

Trees or shrubs, with alternate entire or lobed (not serrate) leaves. Sepals 3, coloured, deciduous. Petals 6–9, deciduous. Stamens hypogynous, indefinite, separate; anthers adnate. Carpels numerous, in many rows on an elongated receptacle. Fruit resembling a cone.

1. LIRIODEN'DRON, L. Tulip-Tree.

The only Canadian species is

L. Tulipif'era, L. A large and stately tree, growing to a great height in many parts of the western peninsula of Ontario. Leaves large, truncate, or with a shallow notch at the end. Flowers large, showy, solitary; petals greenish-yellow, marked with orange. Fruit a dry cone, which, at maturity, separates into dry indehiscent fruits, like samaras.

Order III. ANONA'CEÆ. (Custard-Apple Family.)

Trees or shrubs, with alternate and entire leaves, and solitary, axillary, perfect, hypogynous flowers. Sepals 3. Petals 6, in two sets, deciduous. Stamens numerous. Carpels few or many, fleshy in fruit.

1. ASIM'INA, Adans. North American Papaw.

The only Canadian species is

A. tril'oba, Dunal. (Common Papaw.) Found only in the Niagara peninsula. A small tree, not unlike a young beech in appearance, and forming thickets near Queenston Heights. Flowers purple, appearing before the leaves; the three outer petals much larger than the three inner ones. Fruit 2 to 3 inches long, edible.

Order IV. MENISPERMA'CEÆ. (Moonseed Family.)

Woody twiners, with peltate alternate leaves and small diœcious flowers. Sepals and petals yellowish-white, usually six of each, the petals in front of the sepals. Stamens numerous. Fruit a drupe, in appearance something like a small grape, with moon-shaped seeds.

1. MENISPER'MUM, L. Moonseed.

The only Canadian species is

M. Canadense, L. (Canadian Moonseed.) A twining plant, found, though not abundantly, in low grounds in rich woods. It may be pretty easily recognized by its usually 7-angled thin leaves, which are *peltate near the edge.* Fruit bluish-black,

ORDER V. BERBERIDA'CEÆ. (BARBERRY FAMILY.)

Herbs (or shrubs), with alternate, petiolate, divided leaves. Sepals and petals in fours, sixes, or eights (except in the genus Podophyllum), with the petals in front of the sepals. Stamens (except in Podophyllum) as many as the petals, one before each. Anthers usually opening by a valve at the top. Fruit berry-like, or a pod.

Synopsis of the Genera.

* *Petals and stamens 6.*

1. **Caulophyllum.** A purplish herb, flowering in early spring. Petals thick, much shorter than the sepals.

* * *Petals 6–9. Stamens 8–18.*

2. **Podophyllum.** Petals 6–9. Stamens 12–18. Anthers *not* opening by uplifting valves. Fruit a large berry.
3. **Jeffersonia.** Petals and stamens mostly 8. Anthers opening by uplifting valves. Pod opening by a lid.

1. CAULOPHYL'LUM, Michx. BLUE COHOSH.

C. thalictroi'des, Michx. (BLUE COHOSH.) Plant 1–2 feet high, very glaucous and dull purple when young. Flowers yellowish-green, in a terminal small raceme, appearing in spring before the *decompound leaves* are developed. Sepals 6, with 3 little bractlets at their base. Petals 6, thick and somewhat kidney-shaped, much smaller than the sepals. Stamens 6, one before each petal. Ovary bursting soon after the flowering, and leaving the two drupe-like seeds naked on their rather thick stalks. Fruit bluish, $\frac{1}{4}$ of an inch across.—Rich woods.

2. PODOPHYL'LUM, L. MAY-APPLE. MANDRAKE.

P. peltatum, L. Stem about 1 foot high. Flowerless stems with one large 7–9 lobed umbrella-like leaf, peltate in the centre; the flowering ones with two leaves, peltate near the edge, the flower nodding from the fork. Sepals 6, caducous. Petals 6–9, large and white. Stamens 12–18. Fruit large, oval, yellowish, not poisonous.—Found in patches in rich woods. The leaves and roots are poisonous.

3. JEFFERSONIA, Barton. TWIN-LEAF.

J. diphyl'la, Pers. A low plant, flowering in early spring; the solitary white flowers on naked scapes. Sepals 4, fugacious, Petals 8. Stamens 8. Ovary pointed. Stigma 2-lobed. Pod pear-shaped, the top forming a lid. Leaves radical, long-petioled; the blades *divided into two leaflets with the outer margins lobed.*—Woods, chiefly in the western peninsula of Ontario.

ORDER VI. NYMPHÆA'CEÆ. (WATER-LILY FAMILY.)

Aquatic herbs with cordate or peltate, usually floating, leaves. Floating flowers on long immersed peduncles. Petals and stamens generally numerous.

Synopsis of the Genera.

1. **Brase'nia.** Sepals and petals each 3 (occasionally 4). Stamens 12–24. Leaves oval, peltate.
2. **Nymphæ'a.** Sepals 4–6. Petals numerous, *white*, imbricated in many rows, gradually passing into stamens, hypogynous or epigynous. Stamens epigynous. Stigmas radiating as in a Poppy-head.
3. **Nu'phar.** Sepals 5–6, *yellow.* Petals many, small and stamen-like. Stamens under the ovary.

1. BRASE'NIA, Schreber. WATER-SHIELD.

B. pelta'ta, Pursh. Stems and under surface of the leaves coated with jelly. Leaves oval, two inches across, peltate. Flowers small, purplish.—Ponds and slow-flowing streams.

2. NYMPHÆ'A, Tourn. WATER-LILY.

1. **N. odora'ta,** Ait. (SWEET-SCENTED WATER-LILY.) Leaves orbicular, cleft at the base to the petiole, 5–9 inches wide, often crimson underneath. *Flower very sweet-scented.* Ponds and slow streams.

Var. **minor,** Sims, has much smaller leaves and flowers, and the latter are often pink-tinted.

2. **N. tubero'sa,** Paine. (TUBER-BEARING W.) Leaves larger and more prominently ribbed than in No. 1, reniform-orbicular, green on both sides. Flower not at all, or only slightly, sweet-scented. Root-stocks producing tubers, which come off spontaneously.—Mostly in slow waters opening into Lake Ontario.

3. NUPHAR, Smith. YELLOW POND-LILY.

1. **N. ad'vena,** Ait. (COMMON Y. P.) Leaves floating, or emersed and erect, thickish, roundish or oblong, cordate. *Sepals 6.*—Stagnant water.

2. **N. lu'teum,** Smith. (SMALL Y. P.) Floating leaves usually not more than two inches across, the sinus very narrow or closed. Flowers hardly an inch across. *Sepals 5.*—Northward, in slow waters.

ORDER VII. SARRACENIA'CEÆ. (PITCHER-PLANT F.)

Bog-plants, easily distinguished by their pitcher-shaped leaves, all radical.

1. SARRACE'NIA, Tourn. SIDE-SADDLE FLOWER.

S. purpu'rea, L. (PURPLE S. HUNTSMAN'S CUP.) Hollow leaves with a wing on one side, purple-veined, curved, with the hood erect and open. Sepals 5, coloured, with 3 small bractlets at the base. Petals 5, fiddle-shaped, curved over the centre of the flower, deep purple. Ovary 5-celled, globose, the short style expanding above into a 5-angled umbrella, with a hooked stigma at each angle. Flowers on naked scapes, nodding.—Bogs.

ORDER VIII. PAPAVERA'CEÆ. (POPPY FAMILY.)

Herbs, with coloured juice and alternate leaves without stipules. Flowers polyandrous, hypogynous. Sepals 2, caducous. Petals 4–12. Stamens numerous, anthers introrse. Fruit a 1-celled pod, with numerous seeds.

1. CHELIDO'NIUM, L. CELANDINE.

C. majus, L. Petals 4, deciduous, crumpled in the bud. *Juice of the plant yellow.* Flower-buds nodding. Flowers small, yellow, in a kind of umbel. Fruit a smooth 1-celled slender pod, from which the two valves fall away, leaving the parietal placentas as a slender framework, with the seeds attached.—Waste places.

2. SANGUINA'RIA, Dill. BLOOD-ROOT.

S. Canadensis, L. Petals 8–12, not crumpled in the bud. Flower-buds not nodding. A stemless plant, with a thick rhizome which emits a *red juice* when cut, and sends up in early spring a single rounded, 5–7-lobed, thickish leaf, and a 1-flowered scape. *Flowers white.*—Rich woods.

ORDER IX. FUMARIA'CEÆ. (FUMITORY FAMILY.)

Smooth herbs, with brittle stems, watery juice, dissected leaves and irregular flowers. Sepals 2, very small. Corolla flattened and closed, of 4 petals, the two inner united by their tips over the anthers of the 6 stamens. Stamens in two sets of 3 each; filaments often united; the middle anther of each set 2-celled, the others 1-celled. Fruit a 1-celled pod.

Synopsis of the Genera.

1. **Adlu'mia.** Corolla 2-spurred. Petals all permanently united. *Plant climbing.*
2. **Dicen'tra.** Corolla 2-spurred. Petals slightly united, easily separated. Not climbing.
3. **Coryd'alis.** Corolla 1-spurred. Fruit a slender pod, many-seeded.

1. ADLU'MIA, Raf. CLIMBING FUMITORY.

A. cirrho'sa, Raf. A smooth vine, climbing by the petioles of its decompound leaves. Flowers in axillary pendulous clusters, pale pink.—Low and shady grounds.

2. DICEN'TRA, Bork. DUTCHMAN'S BREECHES.

1. **D. Cucullaria**, DC. (DUTCHMAN'S BREECHES.) Leaves all radical, multifid; these and the slender scape rising from a bulb-like rhizome of coarse grains. Flowers several in a raceme, whitish, spurs *divergent, elongated, acute, straight.*—Rich woods.

2. **D. Canadensis**, DC. (SQUIRREL CORN.) Underground shoots bearing small yellow tubers, something like grains of corn. Leaves very much as in No. 1. Corolla merely *heart-shaped; spurs very short and rounded.* Flowers greenish-white, fragrant. —Rich woods.

3. CORYD'ALIS, Vent. CORYDALIS.

1. **C. au'rea**, Willd. (GOLDEN CORYDALIS.) *Stems low and spreading.* Leaves dissected. *Flowers in simple racemes, golden yellow.* Pods pendulous.—Rocky river-margins and burnt woods.

2. **C. glauca**, Pursh. (PALE CORYDALIS.) *Stems upright*, 1-4 feet high. *Flowers in compound racemes, purplish tipped with yellow.* Pods erect.—Rocky woods.

ORDER X. CRUCIF'ERÆ. (CRESS FAMILY.)

Herbs with a pungent watery juice, alternate leaves without stipules, and regular hypogynous flowers in racemes or corymbs. Pedicels without bractlets. Sepals 4, deciduous. Petals 4, forming a cross-shaped corolla. Stamens 6, two of them shorter. Fruit a silique, or silicle. (See Chap. IV., Part I., for dissection of typical flower.) The genera are distinguished by the pods and seeds, the flowers in all cases being much alike. The seeds are exalbuminous, consisting entirely of the embryo, which is folded up in a variety of ways. The radicle may be bent so as to lie against the *edge* of the cotyledons, and the seed when cut through crosswise shows this section: ; the cotyledons are then said to be *accumbent*. Or the radicle may be folded against the *back* of the cotyledon, showing this cross-section: , in which case the cotyledons are said to be *incumbent;* and if, besides, being incumbent, the cotyledons are doubled round the radicle, thus: , they are then *conduplicate*.

Synopsis of the Genera.

* *Pod a silique (much longer than broad).*

1. **Nastur'tium.** Flowers white or yellow. Pod terete, oblong-linear or ellipsoid. Seeds in two rows in each cell, globular, without a wing. Cotyledons accumbent.
2. **Denta'ria.** Flowers white or pale purple. Pod lanceolate, flat. Seeds wingless, on broad seed-stalks. *Stem-leaves 2 or 3 in a whorl;* stem naked below. Root-stock toothed or tuberous. Cotyledons accumbent.
3. **Cardam'ine.** Flowers white or rose-coloured. Pod linear or lanceolate, flat. Seeds wingless, on slender seed-stalks. Stem leafy below. Cotyledons accumbent.
4. **Ar'abis.** Flowers white or whitish. Pod linear or *elongated*, flattened, *the valves usually with a distinct mid-rib.* Stem leafy. Cotyledons accumbent.
5. **Erys'imum.** Flowers yellow. Pod linear, distinctly 4-sided. *Pedicels of the pods diverging from the stem.* Leaves simple. Cotyledons incumbent.
6. **Sisym'brium.** Flowers yellow. Pods awl-shaped, or 4–6-sided, close pressed to the stem, the valves 1–3-nerved. *Pods sessile* or nearly so. Leaves runcinate. Cotyledons incumbent.
7. **Bras'sica.** Flowers yellow. Pod linear or oblong, nearly terete, or 4-sided, *with a distinct beak extending beyond the end of the valves.* Cotyledons conduplicate.

** * Pod a silicle (comparatively short).*

+ Silicle compressed parallel with the broad partition, or globular.

8. **Draba.** Flowers white. Pod flat, *twisted when ripe, many-seeded.* Cotyledons accumbent.
9. **Alys'sum.** Flowers pale yellow or white. Pod orbicular, flat, 2–4-seeded.
10. **Camel'ina.** Flowers yellow. Pod pear-shaped, pointed, valves 1-nerved. Cotyledons incumbent.

+ + Silicle compressed contrary to the narrow partition.

11. **Capsel'la.** Flowers white. Pod obcordate-triangular, valves boat-shaped, *wingless. Seeds numerous.* Cotyledons incumbent.
12. **Thlas'pi.** Flowers white. Pod obovate or obcordate, *winged.* Seeds several. Cotyledons accumbent.
13. **Lepid'ium.** Flowers white or whitish. Pod roundish, very flat, the valves boat-shaped and *winged. Seeds solitary.*

+ + + Silicle fleshy, jointed.

14. **Caki'le.** Flowers purplish. Pod 2-jointed, fleshy. Leaves fleshy. Cotyledons accumbent.

1. NASTUR'TIUM, R. Br. Water-Cress.

1. **N. officina'le,** R. Br. (Water Cress.) Flowers white. Stem spreading and rooting. Leaves pinnate; leaflets 3–11, roundish or oblong, nearly entire. Pods oblong-linear.—Ditches and streamlets.

2. **N. palustre,** DC. (Marsh Cress.) Flowers yellow. Stem erect. Leaves pinnately parted, the lobes cut-toothed. Pods ovoid.—Wet places.

3. **N. lacus'tre,** Gray. (Lake Cress.) Flowers white. An aquatic plant, with the submerged leaves finely dissected ; the leaves out of the water oblong, and either entire, serrate, or pinnatifid. Pods ovoid, 1-celled.

4. **N. Armora'cia,** Fries. (Horseradish.) Has escaped from gardens in many places. Flowers white. Root-leaves very large, oblong, and generally crenate ; stem-leaves lanceolate. Pods globular. Roots very large.

2. DENTA'RIA, L. Toothwort. Pepper-root.

1. **D. diphyl'la,** L. (Two-leaved T.) Flowers white. *Stem-leaves 2, nearly opposite,* ternately divided. Root-stock toothed, pleasantly pungent to the taste.—Rich woods.

2. **D. lacinia'ta,** Muhl. (Laciniate T.) Flowers purplish. *Stem-leaves 3 in a whorl.* Root-stock jointed, scarcely toothed. —Along streams.

3. CARDAMI'NE, L. Bitter Cress.

1. **C. rhomboi'dea,** DC. (Spring Cress.) Flowers white or (in var. **purpurea**) rose-purple. *Stem tuberous at the base.* Lower leaves round-cordate ; upper nearly lanceolate ; all somewhat angled or toothed.—Wet meadows.

2. **C. pratensis,** L. (Cuckoo-Flower. Ladies' Smock.) Flowers white or rose-colour, showy. Stem from a short rootstock. Leaves pinnate, leaflets 7–15, those of the lower leaves rounded and stalked, entire or nearly so.—Bogs.

3. **C. hirsu'ta,** L. (Small Bitter Cress.) Flowers white, small. Root fibrous. Leaves pinnate, leaflets 5–11, the terminal leaflets largest. Pods erect, slender.—Wet places.

4. AR'ABIS, L. Rock Cress.

* *Seeds in one row in each cell, nearly as broad as the partition.*

1. **A. lyra'ta,** L. (Low R.) Flowers white, twice as long as the calyx. Radical leaves clustered, pinnatifid, the terminal lobe largest; stem-leaves scattered. Pods slender, erect, and spreading.—Rocky or sandy shores.

2. **A. hirsu'ta,** Scop. (Hairy R.) Flowers greenish-white, small, slightly longer than the calyx. Stem-leaves many, rough, sagittate. *Pods erect, straight.* Stems 1–2 feet high, 2 or 3 from the same root.—Rocky shores and dry plains.

3. **A. læviga'ta,** DC. (Smooth R.) Flowers white, rather small. Leaves linear or lanceolate, entire or slightly toothed, sagittate, clasping. Pods long and narrow, *recurved-spreading.* Stem glaucous, 1–2 feet high.—Dry hill-sides. Easily recognized by the pods.

4. **A. Canadensis,** L. (Sickle-Pod.) Flowers whitish, with linear petals, about twice the length of the calyx. Stem-leaves pointed at both ends, downy. Pods 2–3 inches long, *scythe-shaped, hanging.* Stem 2–3 feet high. A striking plant when the pods are fully formed.—Dry woods and ravines.

* * *Seeds in two distinct rows in each cell, narrower than the partition.*

5. **A. perfolia'ta,** Lam. (Tower Mustard.) Flowers yellowish-white. Petals scarcely longer than the calyx. Stem 2–4 feet high, *glaucous.* Cauline leaves ovate-lanceolate or oblong,

clasping with sagittate base. Pods long and *very narrow, on erect pedicels.*—Meadows and old fields. Pretty easily recognized by its strict habit.

6. **A. Drummond'ii,** Gray. Flowers white or rose-coloured. Petals twice as long as the calyx. Stem 1–2 feet high, *smooth above.* Cauline leaves lanceolate or oblong-linear, with sagittate base. Pods long and flat; *the pedicels not so strictly erect* as in the last species.—Rocky banks of streams.

5. ERYS'IMUM, L. Treacle Mustard.

E. cheiranthoi'des, L. (Worm-seed Mustard.) Flowers yellow; inconspicuous. Leaves lanceolate, scarcely toothed, roughish with appressed pubescence.—Waste wet places.

6. SISYM'BRIUM, L. Hedge Mustard.

S. officina'le, Scop. (Hedge Mustard.) Flowers yellow, small. Leaves runcinate. Stem 1–2 feet high, with spreading branches.—A very common roadside weed.

7. BRAS'SICA, Tourn. Cabbage, Mustard, Etc.

1. **B. Sinapis'trum,** Bois. (Charlock.) Flowers bright yellow. Stem 1–2 feet high, branching, it and the leaves hairy. —Too common in our grain-fields.

2. **B. nigra.** (Black Mustard.) Flowers sulphur-yellow. Stem 3–6 feet high, round, smooth, and branching. Lower leaves lyrate,—Fields and waste places.

8. DRABA, DC. Whitlow-Grass.

D. arab'isans, Michx. Flowers white. Stem leafy, erectly branched, pubescent. Leaves lanceolate or linear, minutely dentate. Raceme short, erect. Pods half an inch long, twisted when ripe.—Rocky places.

9. ALYS'SUM, Tourn. Alyssum.

A. calyci'num, L. A dwarf hoary annual, with linear-spathulate leaves. Calyx persistent. Pod 4-seeded, sharp-edged.—Rather rare.

10. CAMEL'INA, Crantz. False Flax.

C. sati'va, Crantz. (Common F. Flax.) Flowers yellowish. Stem 1–2 feet high, straight, erect, branching. Leaves lanceolate, sagittate. Pods pear-shaped, large, margined.—In flax-fields.

11. **CAPSEL'LA**, Vent. Shepherd's Purse.

C. Bursa-pasto'ris, Mœnch. Flowers small, white. Root-leaves clustered, pinnatifid; stem-leaves clasping, sagittate.—A very common weed.

12. **THLASPI**, Tourn. Pennycress.

T. arvense, L. (Field Pennycress.) A low smooth plant, with undivided radical leaves, and stem-leaves sagittate and clasping. Pods half an inch broad, deeply notched at the top.—Waste places.

13. **LEPID'IUM**, L. Peppergrass.

1. **L. Virgin'icum**, L. (Wild P.) Flowers small; *petals present*, white. Stem 1–2 feet high. Leaves lanceolate, the upper linear or lanceolate and entire, the lower toothed or pinnatifid, tapering towards the base. Pods marginless or nearly so, oval or orbicular.—Along railways and roadsides.

2. **L. interme'dium**, Gray. Distinguished from No. 1 by having the cotyledons incumbent instead of accumbent, and the pods minutely winged at the top.—Dry sandy fields.

3. **L. rudera'le**, L. *Petals always absent.* More branched than the preceding.

4. **L. campestre**, L. Well distinguished from other species by its *sagittate, clasping* leaves. Pods ovate, winged.—Rather rare.

14. **CAKI'LE**, Tourn. Sea-Rocket.

C. America'na, Nutt. (American S.) Flowers purplish. Leaves obovate, fleshy, wavy-toothed. Pod fleshy, 2-jointed.—Seashore, and borders of the Great Lakes.

Order XI. CAPPARIDA'CEÆ. Caper Family.

Herbs (in Canada), with an acrid watery juice, and alternate palmately-compound leaves. Flowers cruciform. Stamens 8 or more. Pod like that of a crucifer, *but only 1-celled*,

1. **POLANIS'IA**, Raf. Polanisia.

The only species in Canada is

P. grave'olens, Raf. A strong-scented herb, with a viscid, hairy stem. Leaflets 3. Flowers in terminal racemes. Sepals 4. Petals 4, yellowish-white, narrowed below into long claws. Stamens 8–12, exserted. Pod glandular-pubescent, 2 inches long, linear.—Shore of Lake Ontario, Hamilton to Niagara.

Order XII. VIOLA'CEÆ. (Violet Family.)

Herbs, with alternate stipulate leaves. Flowers irregular, the lower of the 5 petals being spurred. Sepals 5, persistent. Stamens 5, the anthers slightly united and surrounding the pistil. Fruit a 1-celled pod, splitting into 3 valves. Seeds in 3 rows on the walls of the ovary. The only genus represented in this country is

VI'OLA, L. Violet.

* *Stemless Violets ; leaves and scapes all from root-stocks.*

+ *Flowers white.*

1. **V. blanda,** Willd. (Sweet White V.) Lower petal streaked with purple. Leaves round, heart-shaped or reniform. Petals beardless. Flower sweet-scented.—Swamps and wet meadows, in spring.

2. **V. renifo'lia,** Gray. (Kidney-leaved V.) Leaves *much larger and more pubescent* than those of the preceding.—Dry cedar swamps, and ravines in rich woods.

+ + *Flowers blue or purple.*

3. **V. Selkirk'ii,** Pursh. (Great-spurred V.) A small and delicate plant, distinguished from the two following species by the *slender* root-stock, and the *very large spur, thickened at the end.* The pale violet petals, also, are *beardless.*—Damp, shady places.

4. **V. cuculla'ta,** Ait. (Common Blue Violet.) *Leaves on very long petioles,* cordate or reniform, the sides folded inwards when young. Lateral petals bearded. Spur short and thick. —Low grounds everywhere.

5. **V. sagitta'ta,** Ait. (Arrow-Leaved V.) Smoothish. Leaves cordate, halberd-shaped, or sagittate, slightly toothed,

the first ones on short and margined petioles. Side-petals bearded. —Dry hill-sides and old pastures.

* * *Leafy-stemmed Violets.*

+ *Flowers yellow.*

6. **V. pubes'cens,** Ait. (DOWNY YELLOW V.) Plant downy. Leaves broadly cordate, coarsely serrate ; stipules large, dentate. Lower petals veined with purple. Spur very short.—Rich woods.

+ + *Flowers not yellow.*

7. **V. Canadensis,** L. (CANADA VIOLET.) Tall, often a foot high. Leaves large, cordate, serrate-pointed. Petals white inside, *purplish outside.* Spur very short.—Flowering all summer.

8. **V. cani'na,** L., var. **sylvestris,** Regel. (DOG V.) Low, spreading by runners. Leaves broadly cordate or reniform, *with fringed-toothed stipules.* Spur cylindrical, half as long as the petals, which are *pale purple.*—Wet places.

9. **V. stria'ta,** Ait. (PALE V.) Stem angular, 6–10 inches high. Leaves cordate, finely serrate ; stipules fringed-toothed. Spur thickish, much shorter than the *cream-coloured or white petals.*—Low grounds.

10. **V. rostra'ta,** Pursh. (LONG-SPURRED V.) Distinguished at once by its extremely long straight spur. Petals violet-coloured.

ORDER XIII. CISTA'CEÆ. (ROCK-ROSE FAMILY.)

Herbs or low shrubs, with simple entire leaves and regular polyandrous flowers. Calyx persistent, usually of 3 large and 2 smaller sepals. Petals 5 or 3, convolute in the bud. Stamens 3–20. Pod 1-celled, 3-valved. Seeds on 3 parietal projections.

Synopsis of the Genera.

1. **Helian'themum.** Petals 5, fugacious. Style none.
2. **Hudso'nia.** Petals 5, fugacious. Style long and slender.
3. **Lech'ea.** Petals 3, persistent. Style none.

1. HELIAN'THEMUM, Tourn. ROCK-ROSE.

H. Canadense, Michx. (FROST-WEED.) Flowers of 2 sorts, some solitary, with large yellow corolla and many stamens, the petals lasting but one day after the flower opens; others small, clustered in the axils of the leaves, and apetalous. Leaves lanceolate, downy beneath.—Sandy places.

2. **HUDSO'NIA**, L. HUDSONIA.

H. tomento'sa, Nutt. (DOWNY H.) *Hoary*. Leaves oval or narrowly oblong, short, close-pressed, or imbricated. Flowers small, *yellow, very numerous.*—A little heath-like shrub, on the shores of the Great Lakes, and the River St. Lawrence.

3. **LECH'EA**, L. PINWEED.

L. minor, Lam. (SMALLER P.) Flowers inconspicuous, purplish, loosely racemose, on distinct pedicels. Stem slender, rough with appressed scattered hairs. Leaves scattered, linear. Pods the size of a pin's head.—Dry soil.

ORDER XIV. DROSERA'CEÆ. (SUNDEW FAMILY.)

Low glandular-hairy marsh herbs, with circinate tufted radical leaves, and regular hypogynous flowers borne on a naked scape. Sepals, petals, and stamens, 5 each; anthers turned outwards. Styles 3–5, deeply 2-parted. Pod 1-celled, 3-valved. The only genus with us is

DROS'ERA, L. SUNDEW.

1. **D. rotundifo'lia,** L. (ROUND-LEAVED SUNDEW.) Flowers small, white, in a 1-sided raceme. Leaves orbicular, abruptly narrowed into the hairy petiole, clothed with reddish glandular hairs.—Bogs.

2. **D. longifo'lia,** L. (LONGER-LEAVED S.) has oblong-spathulate leaves gradually narrowed into erect naked petioles.—Bogs; not common.

ORDER XV. HYPERICA'CEÆ. (ST. JOHN'S WORT F.)

Herbs or shrubs, with *opposite entire dotted leaves,* and no stipules. Flowers regular, hypogynous, mostly yellow. Sepals 5, persistent. Petals 5, deciduous. Stamens mostly numerous, and *usually in 3 or more clusters.* Stamens 3–5, sometimes united. Pod 1–5-celled. Seeds numerous.

Synopsis of the Genera.

1. **Hyper'icum.** Petals 5, *unequal-sided*, convolute in the bud, *yellow.*
2. **Elo'des.** Petals 5, *equal-sided*, imbricated in the bud, *purplish.*

1. HYPER'ICUM, L. ST. JOHN'S WORT.

* *Pod 3-celled. Styles 3, separate. Petals with black dots.*

1. **H. perfora'tum,** L. (COMMON ST. JOHN'S WORT.) Stem much branched, *producing runners at the base*, slightly 2-edged. Leaves linear-oblong, *with transparent dots*, easily observed by holding the leaf up to the light. *Petals deep yellow.* Flowers in open leafy cymes.—Fields.

2. **H. corymbo'sum,** Muhl. (CORYMBED S.) Stem rounded, not so branching as No. 1. *Leaves with both black and transparent dots*, oblong, somewhat clasping. Flowers *small, pale yellow, crowded.*—Damp woods and wet places generally.

** *Pod 5-celled. Styles more or less united. Stamens very many, in 5 clusters, if clustered at all.*

3. **H. pyramida'tum,** Ait. (GREAT ST. JOHN'S WORT.) Stem 3–5 feet high. Leaves 2–3 inches long, somewhat clasping. *Flowers very large, the petals about an inch long*, and narrowly obovate. Stamens showy. Pod conical, large.—Along streams; not common.

4. **H. Kalmia'num,** L. (KALM'S S.) *Shrubby*, a foot or more in height; leaves linear-lanceolate, crowded, revolute on the margins, thickly punctate, and sessile. Flowers about 1 inch across, in clusters.—Niagara Falls and westward.

* * * *Pod 1-celled, purple.*

5. **H. ellip'ticum,** Hook. (ELLIPTICAL-LEAVED S.) Stem about 1 foot high, *not branched.* Leaves spreading, elliptical-oblong, obtuse, thin. Flowers rather few, showy, in a nearly naked cyme. Pod purple, ovoid, obtuse. Petals pale yellow.—Banks of streams, eastward.

6. **H. mu'tilum,** L. (SMALL S.) Stem slender, branching above, hardly a foot high. Leaves 5-nerved. Cymes leafy at the base. *Flowers small*, not ¼ of an inch across.—Low grounds.

7. **H. Canadense,** L. (CANADA S.) Stem upright, 6–15 inches high, with branches erect. Leaves linear or linear-lanceolate, 3-nerved at the base, the upper ones acute, sessile. Cymes

naked. Pod much longer than the calyx. Flowers small, deep yellow.—Wet, sandy places.

2. **ELO'DES.** Adans. MARSH ST. JOHN'S WORT.

E. Virgin'ica, Nutt. Stem smooth. Leaves oblong or oval, clasping, often purple-veined, obtuse, conspicuously dotted beneath. Flowers flesh-coloured in the axils, and at the summit of the stem. The whole plant is of a purplish hue.—Marshes.

ORDER XVI. CARYOPHYLLA'CEÆ. (PINK FAMILY.)

Herbs with opposite and entire leaves, *the stems swollen at the joints.* Flowers regular, with the parts mostly in fives, occasionally in fours. Stamens not more than twice as many as the petals. Styles 2–5, stigmatic along the inner side. Pod usually 1-celled, with the seeds attached to the base, or to a column which rises from the centre of the cell. (Part I., Fig. 194.)

Synopsis of the Genera.

* *Sepals united into a tube or cup. Petals and stamens borne on the stalk of the ovary: petals with long narrow claws.*

1. **Sapona'ria.** Calyx cylindrical. Styles 2.
2. **Sile'ne.** Calyx 5-toothed. Styles 3.
3. **Lych'nis.** Calyx 5-toothed. Styles 5.

* * *Sepals separate to the base or nearly so. Petals without claws, they and the stamens inserted at the base of the sessile ovary.*

4. **Arena'ria.** Petals not cleft at the apex. Styles usually 3. Pod splitting into 3 or 6 valves.
5. **Stella'ria.** Petals 2-cleft at the apex. Pod splitting to the base into twice as many valves as there are styles. Styles generally 3.
6. **Ceras'tium.** Petals 2-cleft, or notched. Styles 5. Pod opening at the apex by 10 teeth.

1. **SAPONA'RIA,** L. SOAPWORT.

S. officina'lis, L. (BOUNCING BET.) A stout plant, with rose-coloured or pinkish flowers clustered in corymbs. Leaves 3–5-ribbed, the lower ovate, upper lanceolate. Pod raised on a short stalk. Styles 2.—Old gardens and roadsides.

2. **SILE'NE,** L. CATCHFLY. CAMPION.

1. **S. infla'ta,** Smith. (BLADDER CAMPION.) Pale or glaucous, very smooth. Stem erect, a foot high. Leaves ovate-lanceolate. *Calyx much inflated, purple-veined.* Stamens and styles exserted. —Not common westward.

2. **S. antirrhi'na**, L. (SLEEPY C.) Stem slender, simple or slightly branching above, a portion of the upper internodes sticky. Leaves linear or lanceolate. Flowers small, pink or purplish, opening only for a short time in sunshine. Calyx ovoid, shining.—Dry soil.

3. **S. noctiflo'ra**, L. (NIGHT-FLOWERING CATCHFLY.) *Stems very sticky, pubescent.* Lower leaves spathulate, upper lanceolate. Flowers few, *peduncled.* Calyx-tube with awl-shaped teeth. Petals white or whitish, 2-parted. Opening only at night or in cloudy weather.—A very common weed in cultivated grouds.

4. **S. Virgin'ica**, L. (FIRE PINK.) Occurs in south-western Ontario, and may be recognized by its *crimson petals,* and bell-shaped calyx, nodding in fruit.

3. LYCH'NIS, Tourn. COCKLE.

L. Githa'go, Lam. (CORN COCKLE.) Plant clothed with long soft appressed hairs. *Calyx-lobes extremely long,* very much like the upper leaves, surpassing the *purple petals.*—Wheat-fields.

4. ARENA'RIA, L. SANDWORT.

1. **A. serpyllifo'lia**, L. (THYME-LEAVED S.) Much branched, 2–6 inches high, roughish-pubescent. Leaves small, ovate, acute. Petals white, hardly as long as the sepals. Sepals pointed, 3–5-nerved. Pod pointed, 6-toothed.—Sandy fields.

2. **A. stricta**, Michx. (*A. Michauxii,* Hook., in Macoun's Catalogue.) Stems erect, or diffusely spreading from a small root. Leaves awl-shaped or bristle-form, the upper ones reduced to 1-nerved bracts, crowded in the axils. Cyme diffuse, many-flowered. Sepals pointed, *3-ribbed,* half as long as the white petals.—Rocky fields.

3. **A. lateriflo'ra**, L. Stem erect, slender, minutely pubescent. Leaves oval or oblong, ½–1 inch long. Peduncles usually three-flowered. Sepals obtuse. Petals white, large, twice as long as the sepals. Flower ⅓ of an inch across when fully expanded.—Gravelly shores.

4. **A. peploi'des**, L., with *very fleshy stems and leaves,* the latter somewhat clasping, occurs eastward towards the sea-coast.

5. STELLA'RIA, L. Chickweed. Starwort.

1. **S. media,** Smith. (Common Chickweed.) Stems branching, decumbent, soft and brittle, *marked lengthwise with one or two pubescent lines.* Lower leaves on hairy petioles, *ovate.* Flowers small, white. *Petals shorter than the sepals.*—Extremely common in damp grounds and old gardens.

2. **S. longifo'lia,** Muhl. (Long-leaved Stitchwort.) Stems branching, very weak and brittle, supporting themselves on other plants. *Leaves linear.* Pedicels of the flowers long, slender, and spreading, reflexed. Petals white, longer than the 3-nerved sepals. Low grassy banks of streams.

6. CERAS'TIUM, L. Mouse-ear Chickweed.

1. **C. vulga'tum,** L. (Common M.) Stem ascending, hairy and somewhat clammy. *Leaves ovate* or *obovate, obtuse.* Flowers in *close clusters. Pedicels not longer than the sepals.* Petals shorter than the calyx.—Not common, sometimes confounded with No. 2.

2. **C. visco'sum,** L. (Larger M.) Stems hairy, viscid, spreading. *Leaves lanceolate-oblong, rather acute.* Flowers in loose cymes. *Pedicels longer than the sepals.* Petals equalling the calyx.—Fields and copses; common.

3. **C. arven'se,** L. (Field Chickweed.) Stem decumbent at the base, pubescent, slender, 4–8 inches high. Leaves linear, a or linear-lanceolate, *often fascicled in the axils,* longer than the lower internodes. Petals obcordate, more than twice as long as the calyx. Pod scarcely longer than the calyx. Cyme few-flowered.

4. **C. nu'tans,** Raf. Stems very clammy-pubescent and branching diffusely. The loose and open cymes many-flowered. Leaves lance-oblong. *Pods nodding on the stalks, curved upwards, thrice the length of the calyx.*—In places where water lies in spring.

Order XVII. PORTULACA'CEÆ. (Purslane F.)

Herbs with fleshy entire exstipulate leaves, and regular hypogynous or perigynous flowers. Sepals 2. Petals 5. Stamens 5–20. Styles 3–8, united below. Pod 1-celled, few or many-seeded.

Synopsis of the Genera.

1. **Portula'ca.** Stamens 8–20. Pod opening by a lid (Fig. 207, Part I.), many-seeded.
2. **Clayto'nia.** Stamens 5. Pod 3-valved, 3–6-seeded.

1. PORTULA'CA, Tourn. PURSLANE.

P. olera'cea, L. (COMMON PURSLANE.) A low fleshy herb, very smooth, with obovate or wedge-shaped leaves. Calyx 2-cleft, the sepals keeled. Petals yellow, fugacious.—A common pest in gardens.

2. CLAYTO'NIA, L. SPRING-BEAUTY.

1. **C. Virgin'ica,** L. Leaves *linear-lanceolate,* 3–6 inches long.

2. **C. Carolinia'na,** Michx. Leaves *ovate-lanceolate* or oblong, tapering at the base. In both species the corolla is rose-coloured, with dark veins. The stem springs from a small tuber, and bears two opposite leaves and a loose raceme of flowers.—Rich woods in early spring.

ORDER XVIII. MALVA'CEÆ. (MALLOW FAMILY.)

Herbs, with palmately-veined alternate stipulate leaves. Flowers regular. Calyx valvate. Corolla convolute in the bud. Sepals 5, united at the base. Petals 5, hypogynous. Stamens numerous, monadelphous, hypogynous; anthers 1-celled. Carpels united in a ring, separating after ripening. Seeds kidney-shaped.

Synopsis of the Genera.

1. **Malva.** Carpels without beaks, 1-seeded. A circle of 3 bractlets at the base of the calyx.
2. **Abu'tilon.** Carpels 2-beaked, 1–6-seeded. No circle of bractlets.

1. MALVA, L. MALLOW.

1. **M. rotundifo'lia,** L. (ROUND-LEAVED MALLOW.) Stems several, procumbent, from a stout tap-root. Leaves long-petioled, round-heart-shaped, crenate, crenately-lobed. Petals obcordate, whitish, streaked with purple, twice as long as the sepals.—Waysides and cultivated grounds.

2. **M. sylves'tris,** L. (HIGH M.) *Stem erect,* 2 feet high. *Leaves sharply 5–7-lobed. Petals purple,* 3 times as long as the sepals.—Near dwellings.

3. **M. moscha'ta**, L. (MUSK M.) Stem erect, 1 foot high. *Stem-leaves 5-parted, the divisions cleft.* Flowers large and handsome, rose-coloured or white, on short peduncles, crowded on the stem and branches.—Roadsides near gardens.

2. **ABU'TILON**, Tourn. INDIAN MALLOW.

A. Avicen'næ, Gærtn. (VELVET-LEAF.) Stem 2–5 feet high, branching. Leaves velvety, round-cordate, long-pointed. Corolla yellow.—Near gardens ; not common.

ORDER XIX. TILIA'CEÆ. (LINDEN FAMILY.)

Trees with fibrous bark, soft and white wood, and heart-shaped and serrate leaves, with deciduous stipules. Flowers in small cymes hanging on an axillary peduncle, to which is attached a leaf-like bract. Sepals deciduous. The only Canadian genus is

TILIA, L. BASSWOOD. WHITEWOOD.

T. America'na, L. (BASSWOOD.) A fine tree, in rich woods. Flowers yellow or cream-coloured, very fragrant. Leaves smooth and green on both sides, obliquely cordate or truncate at the base, sharply serrate. Sepals 5. Petals 5. Fruit a globular nut, 1-celled, 1–2-seeded.

ORDER XX. LINA'CEÆ. (FLAX FAMILY.)

Herbs with entire exstipulate leaves, and regular hypogynous flowers. Sepals, petals, stamens, and styles, 5 each. Filaments united at the base. Pod 10-celled, 10-seeded. Our only genus is

LINUM, L. FLAX.

1. **L. Virginia'num**, L. (VIRGINIA F.) *Flowers yellow, small* (¼ of an inch long), scattered. Stem erect, it and the spreading branches terete. Leaves lanceolate and acute, the lower obtuse and opposite.—Dry soil.

2. **L. stria'tum**, Walt., has the branches *wing-angled*, broader leaves and more crowded flowers than No 1. The whole plant is stouter.

3. **L. usitatis'simum**, L. (COMMON F.) *Flowers blue.* Leaves alternate, linear-lanceolate, acute, 3-veined.—Cultivated grounds.

ORDER XXI. GERANIA'CEÆ. (GERANIUM FAMILY.)

Strong-scented herbs with pentamerous and symmetrical flowers, the filaments usually united at the base, and 5 glands on the receptacle alternate with the petals. Style 5-cleft. Carpels 5, each 2-ovuled (but 1-seeded), they and the lower part of the long styles *attached to a long beak which rises from the receptacle.* In fruit the styles split away from the beak and *curl upwards, carrying the carpels with them.*

Synopsis of the Genera.

1. **Geranium.** Stamens 10, all with anthers.
2. **Ero'dium.** Stamens with anthers, only 5.

1. GERANIUM, L. CRANESBILL.

1. **G. macula'tum,** L. (WILD C.) Stem erect, hairy, about a foot high. Leaves 5–7-parted, the wedge-shaped divisions lobed and cut. Flowers purple, an inch across. *Petals entire,* bearded on the claw, *much longer than the long-pointed sepals.*—Open woods and fields.

2. **G. Carolinia'num,** L. (CAROLINA C.) Stem usually decumbent, hairy. Sepals *awn-pointed,* as long as the *notched* rose-coloured petals.—Waste places.

3. **G. Robertia'num,** L. (HERB ROBERT.) Stems reddish, spreading, pubescent; branches weak. *Leaves 3-divided,* or *pedately 5-divided,* the divisions twice pinnatifid. Sepals awned, shorter than the reddish-purple petals. *Plant with a very strong odour.*—Shaded ravines and moist woods.

4. **G. pusil'lum,** L. (SMALL-FLOWERED C.) Stem procumbent, slender, minutely pubescent. Leaves rounded, kidney-shaped, deeply 5–7-cleft, the divisions wedge-shaped. *Sepals awnless,* about the same length as the purplish petals.—Waste places.

2. ERO'DIUM, L'Her. STORKSBILL.

E. cicuta'rium, L'Her. Stem low and spreading, hairy. *Leaves pinnate,* the leaflets sessile, pinnatifid. Peduncles several-flowered. Styles when they separate from the beak *bearded on the inside.*—Not common.

ORDER XXII. OXALIDA'CEÆ. (WOOD-SORREL F.)

Low herbs with an acid juice and alternate compound leaves, the 3 leaflets obcordate and drooping in the evening. Flowers very much the same in structure as in the preceding Order, but the fruit is a 5-celled pod, each cell opening in the middle of the back (loculicidal), and the valves persistent. Styles 5, separate. The only genus is

OX'ALIS, L. WOOD-SORREL.

1. **O. Acetosel'la,** L. (WHITE WOOD-SORREL.) Scape 1-flowered. Petals *white, with reddish veins.*—Cold woods.

2. **O. stricta,** L. (*O. cornicula'ta*, L., *var. stricta*, Sav., in Macoun's Catalogue.) (YELLOW W.) Peduncles 2–6-flowered, longer than the leaves. *Petals yellow.* Pod elongated, erect in fruit.—Copses and cultivated grounds.

ORDER XXIII. BALSAMINA'CEÆ. (BALSAM FAMILY.)

Smooth herbs, with succulent stems and simple exstipulate leaves. Flowers irregular, the sepals and petals coloured alike, *one of the coloured sepals spurred, the spur with a tail.* Stamens 5, coherent above. Pod bursting elastically, and discharging its seeds with considerable force. The only genus is

IMPA'TIENS, L. TOUCH-ME-NOT. JEWEL-WEED.

1. **I. fulva,** Nutt. (SPOTTED TOUCH-ME-NOT.) *Flowers orange-coloured, spotted with reddish brown.* Sac longer than broad, conical, tapering into a long recurved spur.—Cedar swamps and along streams.

2. **I. pal'lida,** Nutt. (PALE T.) Flowers *pale yellow, sparingly dotted with brown.* Sac dilated, broader than long, ending in a short spur.—Wet places.

ORDER XXIV. RUTA'CEÆ. (RUE FAMILY.)

Shrubs, with compound *transparently-dotted* leaves, and an acrid taste. Flowers (with us) diœcious, appearing before the leaves. Stamens hypogynous, as many as the petals. Our only genus is

ZANTHOX'YLUM, Colden. Prickly Ash.

Z. America'num, Mill. (Northern Prickly Ash.) Tooth-ache Tree.) A prickly shrub, with yellowish-green flowers in dense umbels in the axils. Sepals obsolete or none. Petals 5. Stamens in the sterile flowers 5. Carpels 3–5, forming fleshy 1–2-seeded pods. Fruit very pungent and aromatic. Leaves pinnate, 4–5 pairs, with an odd one at the end.—Forming thickets in low grounds along streams.

Order XXV. ANACARDIA'CEÆ. (Cashew Family.)

Trees or shrubs, with a milky or resinous juice, and alternate leaves without dots or stipules. Sepals, petals, and stamens, each 5. Fruit a 1-seeded drupelet. The petals and stamens inserted under the edge of a disk which surrounds the base of the ovary. The only genus is

RHUS, L. Sumach.

1. **R. typh'ina,** L. (Staghorn Sumach.) A small tree, 10–30 feet high, with *densely soft-hairy branches and stalks.* Flowers greenish-white, polygamous, forming a terminal thyrse. Fruit globular, *covered with crimson hairs.* Leaves pinnate, leaflets 11–31, oblong-lanceolate, serrate, pointed.—Dry hill-sides.

2. **R. glabra,** L., (Smooth S.) is *smooth*, and seldom exceeds 5 feet in height.

3. **R. Toxicoden'dron,** L. (Poison Ivy.) Shrub about a foot high, smooth, often climbing by rootlets. Leaves 3-foliolate, leaflets rhombic-ovate, notched irregularly. Flowers polygamous, in slender axillary panicles. Plant poisonous to the touch. Var. **radi'cans,** L. has the leaves *entire.*

4. **R. venena'ta,** DC. (Poison Elder.) A tall shrub, smooth or nearly so. Leaves odd-pinnate ; leaflets 7–13, obovate-oblong, entire. Greenish-white flowers as in No. 3.—Swamps.

5. **R. aromat'ica,** Ait., (Fragrant S.) is a shrub 2–3 feet high, with 3-foliolate leaves, sweet-scented when crushed, and catkin-like spikes of pale yellow flowers appearing before the leaves.—Not common.

ORDER XXVI. VITA'CEÆ. (VINE FAMILY.)

Shrubs climbing by tendrils, with small greenish flowers in panicled clusters opposite the leaves. Stamens as many as the petals and opposite them. Calyx minute. Petals 4 or 5, hypogynous or perigynous, very deciduous. Fruit a berry, 1–4-seeded. Leaves palmately-veined, or compound.

Synopsis of the Genera.

1. **Vitis.** Leaves simple, heart-shaped, and variously lobed.
2. **Ampelop'sis.** Leaves compound-digitate, of 5 serrate leaflets.

1. VITIS, Tourn. GRAPE.

1. **V. æstiva'lis,** Michx. (NORTHERN FOX-GRAPE.) *Leaves and branches woolly.* Berries large, dark purple or amber-coloured.—Moist thickets.

2. **V. cordifo'lia,** Michx. (FROST GRAPE.) *Leaves smooth* or nearly so, bright green on both sides, heart-shaped, sharply serrate. Berries small, blue or black. Var. **ripa'ria,** Michx., has broader cut-lobed leaves.—Banks of streams.

2. AMPELOP'SIS, Michx. VIRGINIA CREEPER.

A. quinquefo'lia, Michx. A common woody vine in low grounds. Leaves digitate, of 5 oblong-lanceolate leaflets. Tendrils with sucker-like disks at the end, by which they cling to walls, trunks of trees, etc. Fruit a small black berry.

ORDER XXVII. RHAMNA'CEÆ. (BUCKTHORN FAMILY.)

Shrubs with simple stipulate leaves, and small regular perigynous greenish or whitish flowers. Stamens opposite the petals, and with them inserted on the margin of a fleshy disk which lines the calyx-tube. Fruit a berry-like drupe, or a pod.

Synopsis of the Genera.

1. **Rham'nus.** Petals minute, *or none.* Drupe berry-like. Calyx and disk free from the ovary.
2. **Ceano'thus.** Petals white, long-clawed, hooded. Fruit dry, dehiscent. Calyx and disk adherent to the base of the ovary.

1. RHAM'NUS, Tourn. BUCKTHORN.

R. alnifo'lius, L'Her. A low erect shrub, not thorny, with oval, acute, serrate leaves, and apetalous flowers. Fruit a 3-seeded berry.—Swamps.

2. **CEANO'THUS**, L. NEW JERSEY TEA.

1. **C. America'nus**, L. A shrubby plant with downy branches, and ovate, 3-ribbed, serrate leaves. Flowers in white clusters at the summit of the naked flower-branches. Sepals and petals white, the latter hooded, and with slender claws. Pedicels also white.—Dry hill-sides.

2. **C. ova'lis**, Bigel., (*C. ovatus*, Desf., in Macoun's Catalogue) has the leaves narrowly oval or elliptical-lanceolate, finely serrate, and glabrous or nearly so. The flowers, also, are larger than in No. 1.—South-western Ontario.

ORDER XXVIII. CELASTRA'CEÆ. (STAFF-TREE F.)

Shrubs with simple stipulate leaves, alternate or opposite, and small regular flowers, the sepals and petals both imbricated in the bud. Stamens 4–5, alternate with the petals, and inserted on a disk which fills the bottom of the calyx. Pods orange or crimson when ripe.

Synopsis of the Genera.

1. **Euon'ymus.** Flowers perfect. Sepals 4 or 5, united at the base, and forming a *flat calyx.* Branchlets 4-sided; *leaves opposite. Flowers axillary.*
2. **Celas'trus.** Flowers polygamous. Petals and stamens 5. Calyx cup-shaped. *Leaves alternate.* Flowers in *terminal racemes.*

1. **EUON'YMUS**, Tourn. SPINDLE-TREE.

1. **E. America'nus**, L. (STRAWBERRY BUSH.) A low, rather straggling shrub, with *short-petioled* or *sessile leaves*, the latter ovate or obovate, pointed. Flowers greenish, with the parts generally in fives. Pods *rough-warty*, *depressed*, crimson when ripe.—Wooded river-banks and low grounds.

2. **E. atropurpu'reus**, Jacq., (BURNING BUSH) occurs in the west of Ontario, and may be distinguished from No. 1 by its greater size (4–8 feet high), its *long-petioled leaves*, *purplish flowers*, and smooth pods.

2. **CELAS'TRUS**, L. STAFF-TREE.

C. scandens, L. (WAX-WORK. CLIMBING BITTER-SWEET.) A twining smooth shrub, with oblong-ovate, serrate, pointed leaves. Flowers small, greenish, in terminal racemes. Pods orange-coloured. These burst in autumn and display a scarlet pulpy aril, presenting a highly ornamental appearance.—Twining over bushes on river-banks and in thickets.

ORDER XXIX. SAPINDA'CEÆ. (SOAPBERRY FAMILY.)

Trees or shrubs, with compound or lobed leaves, and usually unsymmetrical and often irregular flowers. Sepals and petals 4–5, both imbricated in the bud. Stamens 5–10, inserted on a fleshy disk which fills the bottom of the calyx-tube. Ovary 2–3-celled, with 1 or 2 ovules in each cell.

Synopsis of the Genera.

1. **Staphyle'a.** *Flowers perfect.* Lobes of the coloured calyx, the petals, and the stamens, each 5. *Fruit a 3-celled, 3-lobed, inflated pod.* Leaves pinnately compound.
2. **Acer.** *Flowers polygamous.* Leaves simple, variously lobed, opposite. Calyx coloured, usually 5-lobed. Petals none, or as many as the sepals. Stamens 3–12. *Fruit two 1-seeded samaras* joined together, at length separating.

1. STAPHYLE'A, L. BLADDER-NUT.

S. trifo'lia, L. (AMERICAN BLADDER-NUT.) Shrub, 4–6 feet high. Leaflets 3, ovate, pointed. Flowers white, in drooping racemes, at the ends of the branchlets.—Thickets and hill-sides.

2. ACER, Tourn. MAPLE.

1. **A. Pennsylva'nicum,** L. (STRIPED MAPLE.) A small tree, 10–20 feet high, with light-green bark striped with dark lines. Leaves 3-lobed at the apex, finely and sharply doubly-serrate, the lobes taper-pointed. Flowers greenish, in terminal racemes, appearing after the leaves. Samaras large, with divergent wings.—Rich woods.

2. **A. spica'tum,** Lam. (MOUNTAIN MAPLE.) A shrub or small tree, 4–8 feet high, growing in clumps in low grounds. Leaves 3-lobed, coarsely serrate, the lobes taper-pointed. Flowers greenish, appearing after the leaves, in dense *upright* racemes. Fruit with small widely-diverging wings.

3. **A. sacchari'num,** Wang. (SUGAR MAPLE.) A fine tree, with 3–5-lobed leaves, a paler green underneath, *the sinuses rounded, and the lobes sparingly sinuate-toothed.* Flowers greenish-

yellow, *drooping on slender hairy pedicels*, appearing at the same time as the leaves. Calyx fringed on the margin. Var. **nigrum**, Torr. and Gray, may be distinguished from the ordinary form by its paler and more pubescent leaves.—Rich woods.

4. **A. dasycar'pum,** Ehrhart. (WHITE or SILVER M.) Leaves deeply 5-lobed, the sinuses rather acute, silvery-white underneath, the divisions narrow, sharply-toothed. Flowers in erect clusters, greenish-yellow, *appearing much before the leaves ; petals none.* Samara very large, *woolly when young.*—River-banks and low grounds.

5. **A. ru'brum,** L. (RED M.) Leaves 3–5-lobed, the sinuses acute. *Flowers red*, appearing much before the leaves. *Petals linear-oblong. Samara small and smooth*, on drooping pedicels. A smaller tree than No. 4, with reddish twigs, and turning bright crimson in the autumn.—Swamps.

ORDER XXX. POLYGALA'CEÆ. (MILKWORT FAMILY.)

Herbs with entire exstipulate leaves, and irregular hypogynous flowers. Stamens 6 or 8, monadelphous or diadelphous, the anthers 1-celled, and opening at the top by a pore. Pod 2-celled and 2-seeded, flattened contrary to the partition. The only genus with us is

POLYG'ALA, Tourn. MILK-WORT.

Sepals 5, the upper one and the two lower ones small and often greenish, the 2 lateral ones (called wings) larger and coloured like the petals. Petals 3, connected with each other and with the tube of filaments, the lower one keel-shaped, and usually fringed or crested at the top. Style prolonged and curved.

1. **P. verticilla'ta,** L. Flowers small, greenish-white, in slender spikes. Stems 4–8 inches high, much branched. *Stem-leaves linear, 4–5 in a whorl*, the upper ones scattered.—Dry soil.

2. **P. Sen'ega,** L. (SENECA SNAKEROOT.) Flowers greenish-white, in a solitary cylindrical close spike. Stems several, from a hard knotty rootstock, 6–12 inches high. Leaves lanceolate, with rough margins, alternate.—Dry hill-sides and thickets.

3. **P. polyg'ama,** Walt. Flowers rose-purple, showy, fringed, in a *many-flowered* raceme. Stamens 5–8 inches high, tufted and

very leafy, the leaves linear-oblong or oblanceolate. Whitish fertile flowers on underground runners.—Dry soil.

4. **P. paucifo'lia,** Willd. (FRINGED P.) Flowers rose-purple, very showy, fringed, *only 1–3 in number.* Stems 1–4 inches high, from long underground runners, which also bear concealed fertile flowers. Leaves ovate, crowded at the top of the stem.—Dry woods. A

5. **P. sanguin'ea,** L. Flowers usually bright red-purple, but sometimes pale. Corolla inconspicuously crested. Flowers in *dense globular heads*, at length oblong. True petals mostly shorter than the wings, the latter broadly ovate, closely sessile. Stem leafy to the top; leaves oblong-linear.—Sandy places.

ORDER XXXI. LEGUMINO'SÆ. (PULSE FAMILY.)

Herbs, shrubs, or trees, mostly with compound alternate stipulate leaves, and papilionaceous corollas. (For description of a typical flower, see Part I., cap. v.) Stamens usually 10, monadelphous, diadelphous, or distinct. Fruit a legume.

Synopsis of the Genera.

* *Flowers papilionaceous.*

1. **Lupi'nus.** *Leaves palmately-compound, leaflets 7–9.* Flowers in terminal racemes. *Stamens monadelphous.*
2. **Trifo'lium.** Leaves of 3 leaflets. *Flowers in heads.* Stamens diadelphous.
3. **Medica'go.** Leaves pinnate, of 3 leaflets. Flowers in axillary spikes. *Pod curved or coiled.* Stamens diadelphous.
4. **Melilo'tus.** Leaves pinnate, of 3 leaflets, the leaflets toothed. Flowers in slender axillary racemes. Pod wrinkled, 1–2-seeded. Stamens diadelphous.
5. **Robin'ia.** *Trees.* Leaves odd-pinnate, often with spines for stipules, and the leaflets with small stipules. Flowers in hanging axillary racemes. Pod margined on one edge. Stamens diadelphous.
6. **Astrag'alus.** Leaves odd-pinnate, leaflets numerous. Flowers in dense axillary spikes. Corolla long and narrow. Pod turgid, *one or both sutures* (see Part I., section 217) *projecting into the cell, thus partially or wholly dividing the cavity.* Stamens diadelphous.
7. **Desmo'dium.** Leaves pinnate, of 3 leaflets. *Calyx 2-lipped.* Flowers purple or purplish, in axillary or terminal racemes. Pod flat, *the lower margin deeply lobed, thus making the pod jointed*, roughened with hooked hairs, causing the pods to adhere to the clothing, etc. Stamens diadelphous.
8. **Lespede'za.** Leaves pinnate, of 3 leaflets. *Calyx 5-cleft.* Pod flat, oval or roundish, *occasionally 2-jointed, but only 1-seeded.* Flowers sometimes polygamous. Stamens diadelphous.

9. **Vicia.** Leaves abruptly pinnate, *the leafstalk prolonged into a tendril.* Flowers axillary. *Style filiform, hairy at the apex.* Pod 2-several-seeded. Stamens diadelphous.

10. **Lath'yrus.** Leaves as in Vicia. *Style flattish,* flattened above, and *hairy down the side opposite the free stamen.* Stamens diadelphous.

11. **A'pios.** *A twining herb. Leaves pinnate, 5–7 leaflets.* Keel of the flower slender and *coiled inward.* Flowers in dense racemes. Stamens diadelphous.

12. **Amphicarpæ'a.** *A low and slender twiner,* the stem clothed with brownish hairs. *Leaves pinnate, of 3 leaflets.* Flowers polygamous, those of the upper racemes perfect, those near the base fertile, with the corolla inconspicuous or none. Stamens diadelphous.

13. **Baptis'ia.** Leaves palmate, of 3 leaflets. *Stamens all separate. The keel-petals nearly separate.* Racemes terminating the bushy branches.

** *Flowers not papilionaceous; polygamous. Trees.*

14. **Gledit'schia.** Thorny trees, with abruptly once- or twice-pinnate leaves. Flowers greenish, inconspicuous, in small spikes.

1. LUPI'NUS, Tourn. LUPINE.

L. peren'nis, L. (WILD LUPINE.) Stem erect, somewhat hairy. Leaflets 7–9, oblanceolate. Calyx deeply 2-lipped. Pods hairy.—Sandy soil.

2. TRIFO'LIUM, L. CLOVER. TREFOIL.

1. **T. arvense,** L. (RABBIT-FOOT OR STONE CLOVER.) Stem erect, 4–12 inches high, branching. Heads of whitish flowers oblong, *very silky and soft.* Calyx-teeth fringed with long silky hairs.—Dry fields.

2. **T. pratense,** L. (RED C.) Stems and leaves somewhat hairy, the latter marked with a pale spot on the upper side. Flowers purplish, in dense heads.—Pastures.

3. **T. repens,** L. (WHITE C.) Smooth, creeping. Heads of white flowers rather loose.—Fields everywhere.

4. **T. reflexum,** L. (BUFFALO C.) Only in south-western Ontario, in the neighborhood of the Detroit river. Heads large, on naked peduncles; standard rose-red, wings and keel whitish. Flowers reflexed when old.

5. **T. agrarium,** L. (YELLOW OR HOP-C.) Flowers *yellow,* reflexed when old. Leaflets obovate-oblong, *all 3 from the same point.* Stem 6–12 inches high.—Sandy fields.

6. **T. procumbens,** L. (Low Hop-C.) Flowers yellow, reflexed when old. Leaflets *wedge-obovate,* the lateral ones at a short distance from the terminal one. Stem smaller than in No. 5, spreading.—Sandy fields.

3. MEDICA'GO, L. Medick.

1. **M. lupuli'na,** L. (Black Medick.) Stem procumbent, downy. Leaflets obovate, toothed at the apex. Flowers yellow. Pods kidney-shaped.—Waste places.

2. **M. sati'va,** L., (Lucerne) has *purple flowers* in a long raceme, and *spirally-twisted pods.*—Cultivated fields. H-9

4. MELILO'TUS, Tourn. Sweet Clover.

1. **M. officina'lis,** Willd. (Yellow Melilot.) Stem erect, 2–4 feet high. Leaflets obovate-oblong. Flowers yellow. Pod drooping, 1–2-seeded.—Waste places.

2. **M. alba,** Lam., (White M.) is much like No. 1, but has white flowers.—Escaped from gardens.

5. ROBIN'IA, L. Locust-tree.

1. **R. Pseudaca'cia,** L. (Common Locust.) *Racemes slender, loose.* Flowers white, fragrant. A large tree.

2. **R. visco'sa,** Vent. (Clammy L.) *Racemes crowded.* Flowers white, with a reddish tinge. *Branchlets and leafstalks clammy.* Smaller than No. 1.

6. ASTRAG'ALUS, L. Milk-Vetch.

1. **A. Canaden'sis,** L. (Canadian Milk-Vetch.) Stem erect, 1–4 feet high, somewhat pubescent. Leaflets *10 or more pairs,* with an odd one at the end. *Flowers greenish-yellow, very numerous.*—River-banks.

2. **A. Coop'eri,** Gray, has *fewer leaflets,* and *white flowers* in a short spike.—Not common.

7. DESMO'DIUM, DC. Tick-Trefoil.

* *Pod raised on a stalk much surpassing the calyx, the latter slightly toothed. Stipules bristle-form.*

1. **D. nudiflo'rum,** DC. Stem smooth, 4–8 inches high. Leaves crowded at the summit of sterile stems. Flowers in a terminal raceme or panicle, *on a scape which rises from the root.* Leaflets broadly ovate.

2. **D. acumina'tum,** DC. Stem pubescent. Leaves all crowded at the summit of the stem, *from which the raceme or panicle arises.* Leaflets conspicuously pointed.—Rich woods.

3. **D. pauciflo'rum,** DC. Leaves *scattered* along the low ascending stems; leaflets rhombic-ovate, rather blunt. Racemes few-flowered, terminal.—Rich woods, western Ontario.

* * *Pod raised on a stalk hardly surpassing the calyx, the latter deeply cleft. Stipules ovate, taper-pointed.*

4. **D. rotundifo'lium,** DC. Stem *prostrate, soft-hairy.* Leaflets orbicular. Flowers purple. Pods indented on both edges.—Dry sandy woods, western Ontario.

* * * *Pod hardly, if at all, stalked.*

5. **D. cuspida'tum,** Torr. and Gray. Stem tall, erect, very smooth. Leaflets ovate-lanceolate, taper-pointed, very large, green on both sides. Flowers and bracts large. Pod 4–6-jointed.—Thickets.

6. **D. panicula'tum,** DC. Stem slender, nearly smooth. eaflets oblong-lanceolate, tapering to a blunt point. Flowers medium-sized. Pod 3–5-jointed, the joints triangular. Racemes panicled.—Rich woods.

7. **D. Dille'nii,** Darlingt. Distinguished from the last by the *pubescent* stem and finely pubescent leaflets, the latter *oblong* or *oblong-ovate.*—Dry and open thickets.

8. **D. Canadense,** DC. Stem erect, *hairy,* tall, furrowed. Leaflets oblong-lanceolate (1½–3 inches long), *with many straightish veins.* Flowers large, about ½ inch long, in dense racemes. Joints of the pod roundish.—Dry woods.

9. **D. cilia're,** DC. Stem ascending, slender, hairy. Leaflets round-ovate (½–1 inch long). Flowers small, in *loose racemes.*—Dry thickets, south-western Ontario.

8. LESPEDE'ZA. Bush-Clover.

* *Flowers of two sorts; the larger perfect, the smaller pistillate and usually apetalous, mingled with the others.*

1. **L. viola'cea,** Pers. (*L. reticulata,* Pers., in Macoun's Catalogue.) Stems upright, branched. Leaflets varying from oblong to linear, downy underneath. *Flowers violet-purple.*—Dry borders of woods, western Ontario.

*** All the flowers perfect, in close spikes or heads.*

2. **L. hirta,** L. Stem erect, wand-like, tall, pubescent. Leaflets roundish or oval, pubescent. Spikes dense, on *peduncles longer than the leaves. Corolla yellowish-white,* with a purple spot on the standard.

3. **L. capita'ta,** Michx. *Peduncles and petioles short.* Leaflets varying from oblong to linear, silky underneath. Flowers in *dense heads; corolla as in No. 1.* Calyx much longer than the pod.—Both species are found in dry soil.

9. VICIA, Tourn. VETCH.

1. **V. sati'va,** L. (COMMON VETCH or TARE.) Stem simple, somewhat pubescent. Leaflets 10–14, varying from obovate-oblong to linear. *Flowers purple, large, one or two together, sessile in the axils, or nearly so.*—Cultivated fields and waste grounds.

2. **V. Cracca,** L. (TUFTED V.) Downy-pubescent. *Leaflets 20–24,* oblong-lanceolate, strongly mucronate. *Peduncles long, bearing a dense one-sided raceme of blue flowers,* bent downward in the spike, and turning purple before withering.—Borders of thickets, and pastures. Chiefly eastward.

3. **V. Carolinia'na,** Walt. Smooth. Leaflets 8–12, oblong. Peduncles bearing a *rather loose raceme of whitish flowers, the keel tipped with blue.*—Low grounds and river-banks.

4. **V. America'na,** Muhl. Smooth. *Leaflets 10–14,* oval or ovate-oblong, very veiny. *Peduncles 4–8-flowered, flowers purple.*—Moist places.

5. **V. hirsu'ta,** Koch. Stem weak. *Leaflets 12–16, linear.* Peduncles 3–6-flowered. *Pods hairy, 2-seeded.*—Chiefly eastward.

10. LATH'YRUS, L. EVERLASTING PEA.

1. **L. marit'imus,** Bigel. (BEACH PEA.) Stem stout, about a foot high. Leaflets 8-16, oval or obovate. *Stipules broadly halberd-shaped, about as large as the leaflets.* Flowers large, purple.—Sea-coast, and shores of the Great Lakes.

2. **L. veno'sus,** Muhl. (VEINY E.) Stem 2–3 feet high. Leaflets 10–14. *Stipules very small, slender, half arrow-shaped.* Flowers numerous.—Shady banks, chiefly westward and southward.

3. **L. ochroleu'cus,** Hook. (PALE E.) Stem slender. Leaflets 6–8, smooth and glaucous. *Stipules half heart-shaped, large. Corolla yellowish-white.*—Chiefly northward.

4. **L. palus'tris,** L. (MARSH E.) Stem slender, wing-margined. Leaflets 4–8, lanceolate, linear, or narrowly oblong, sharply mucronate. Stipules small, half arrow-shaped. Corolla blue-purple.—Moist places. Var. **myrtifolius** has oblong-lanceolate leaflets, and pale-purple flowers. Upper stipules much larger than the lower ones.

A'PIOS, Boerhaave. GROUND-NUT. WILD BEAN.

A. tubero'sa, Mœnch. Flowers brown-purple.—A common twining plant in low grounds.

12. AMPHICARPÆ'A, Ell. HOG PEA-NUT.

A. monoi'ca, Nutt. Flowers white or purplish.—Moist thickets and river-banks.

13. BAPTIS'IA, Vent. FALSE INDIGO.

B. tincto'ria, R. Br. (WILD INDIGO.) Smooth and slender, 2–3 feet high, branching. Leaves nearly sessile. Leaflets wedge-obovate, turning black on drying. Flowers yellow.—Dry soil, Lake Erie coast.

14. GLEDIT'SCHIA, L. HONEY-LOCUST.

1. **G. triacan'thos,** L. Thorns stout, often triple or compound. Pods linear, often more than a foot long, with pulp between the flat seeds.—Common in cultivation, and established on Point Pelee.

ORDER XXXII. ROSA'CEÆ. (ROSE FAMILY.)

Herbs, shrubs, or trees, with alternate stipulate leaves, and regular flowers. The petals (mostly 5) and stamens (mostly more than 10) inserted on the edge of a disk which lines the calyx-tube. (See Part I., sections 48 to 57, for typical flowers.)

Synopsis of the Genera.

SUBORDER AMYGDALEÆ.

1. **Pru'nus.** Calyx 5-cleft, free from the ovary, deciduous. Fruit a drupe.

Suborder ROSACEÆ.

2. **Spiræ'a.** Carpels mostly 5, forming follicles in fruit. Calyx 5-cleft, short. Petals obovate, similar.
3. **Gille'nia.** Carpels and fruit as in Spiræa. Calyx elongated, 5-toothed. Petals slender, dissimilar.
4. **Agrimo'nia.** Carpels 2, forming achenes enclosed in the hardened calyx-tube. Calyx armed with hooked bristles. Flowers yellow, in slender spikes.
5. **Geum.** Carpels numerous, one-ovuled, becoming dry achenes, the persistent styles becoming tails, plumose or naked, and straight or jointed. Calyx-lobes with 5 alternating bractlets.
6. **Waldstei'nia.** Carpels 2–6, forming achenes. Leaves radical, of 3 wedge-form leaflets. Bractlets of the calyx minute and deciduous. Flowers yellow, on bracted scapes.
7. **Potentil'la.** Carpels numerous, forming achenes heaped on a dry receptacle, the styles not forming tails. Lobes of the calyx with 5 alternating bracts.
8. **Fraga'ria.** Flowers as in Potentilla, but receptacle becoming fleshy or pulpy and scarlet in fruit. (See Part I., section 235.) Leaves all radical, of 3 leaflets. Low plants producing runners.
9. **Dalibar'da.** Carpels 5–10, each 2-ovuled, forming nearly dry drupelets. Calyx 5–6-parted, 3 of the divisions larger than the others, and toothed. Calyx without bracts, persistent, enclosing the fruit. Leaves radical, round heart-shaped. Flowers white, on scapes.
10. **Rubus.** Carpels numerous, 2-ovuled, forming drupelets heaped on the receptacle. (See Part I., section 234.) Fruit edible. Calyx without bracts.
11. **Rosa.** Carpels numerous, 1-ovuled, forming achenes enclosed in the fleshy calyx-tube. (See Part I., section 49.)

Suborder POMEÆ.

12. **Cratæ'gus.** Calyx-tube urn-shaped, becoming thick and fleshy in fruit, enclosing and combined with the 2–5 carpels. Fruit a pome, but drupe-like, containing 2–5 bony nutlets. *Thorny shrubs.* Flowers generally white.
13. **Pyrus.** Fruit a pome or berry-like, the 2–5 carpels or cells of a papery or cartilaginous texture (see Part I., sections 52 and 232), each 2-seeded. Shrubs or trees.
14. **Amelan'chier.** Pome berry-like, *10-celled*, *i.e.*, with twice as many cells as styles. Petals narrow. Otherwise as in Pyrus. Shrubs or small trees, *not thorny.*

1. PRUNUS, Tourn. Plum. Cherry.

1. **P. Ameri'ca'na,** Marshall. (Wild Plum.) A thorny tree 8–20 feet high, with orange or red drupes half an inch or more in

diameter; and ovate, conspicuously pointed, serrate, veiny leaves. Flowers white, appearing before the leaves, in umbel-like lateral clusters.—Woods and river-banks.

2. **P. pu'mila,** L. (DWARF CHERRY.) A small trailing shrub, 6–18 inches high. Leaves obovate-lanceolate, tapering to the base, toothed near the apex, pale beneath. Flowers in umbels of 2–4, appearing with the leaves. Fruit ovoid, dark red, as large as a good-sized pea.—Sandy or gravelly soil, along the Great Lakes.

3. **P. Pennsylva'nica,** L. (WILD RED CHERRY.) A tree 20–30 feet high, or shrubby. Leaves oblong-lanceolate, sharply serrate, green both sides. Flowers (appearing with the leaves) in large clusters, the pedicels elongated. Fruit globular, as large as a red currant, very sour.—Rocky thickets, and in old windfalls.

4. **P. Virginia'na,** L. (CHOKE-CHERRY.) A good-sized shrub, 3–10 feet high. Leaves oval, oblong, or obovate, finely and sharply serrate, abruptly pointed. Flowers in short erect racemes, appearing after the leaves. Fruit red, becoming darker, very astringent.—Woods and thickets.

5. **P. sero'tina,** Ehrhart. (WILD BLACK CHERRY.) A large tree, with reddish-brown branches. Leaves smooth, varying from oval to ovate-lanceolate, taper-pointed, serrate, with short and blunt incurved teeth, shining above. Flowers in long racemes. Fruit purplish-black, edible.—Woods and thickets.

2. SPIRÆ'A, L. MEADOW-SWEET.

1. **S. opulifo'lia,** L. (*Neillia opulifolia*, Benth. and Hook., in Macoun's Catalogue.) (NINE-BARK.) Shrub 3–7 feet high, the old bark separating in thin layers. Leaves broadly ovate or cordate, 3-lobed, doubly crenate, smooth. Flowers white, in umbel-like corymbs terminating the branches. Follicles 2–5, inflated, purplish.—River-banks.

2. **S. salicifo'lia,** L. (COMMON MEADOW-SWEET.) Shrub 2–3 feet high, nearly smooth. Leaves wedge-lanceolate, doubly serrate. Flowers white or rose-coloured, in a dense, terminal panicle.—Low grounds along streams,

3. **S. tomento'sa**, L., (DOWNY M.) with deep rose-coloured flowers, and the stems and under surface of the leaves densely woolly, occurs eastward towards the sea-coast, and in the northern counties of Ontario.

3. GILLE'NIA, Mœnch. INDIAN-PHYSIC.

G. trifolia'ta, Mœnch. (BOWMAN'S ROOT.) Herb with 3-foliolate leaves; the leaflets ovate-oblong, pointed, rather coarsely serrate; stipules small, awl-shaped, entire. Flowers white or rose-coloured, in loose few-flowered corymbs.—Rich woods, chiefly south-westward.

4. AGRIMO'NIA, Tourn. AGRIMONY.

A. Eupato'ria, L. (COMMON AGRIMONY.) Stem herbaceous, hairy, 2–3 feet high. Leaves interruptedly pinnate, larger leaflets 5–7, oblong-obovate, coarsely serrate. Petals yellow, twice as long as the calyx.—Borders of woods.

5. GEUM, L. AVENS.

1. **G. album**, Gmelin. (WHITE AVENS.) Stem 2 feet high, slender, branching, smoothish or downy. Root-leaves pinnate, the cauline ones 3-divided, lobed, or only toothed. *Petals white*, as long as the calyx. Achenes bristly, tipped with the hooked lower joint of the style, the upper joint falling away. *Receptacle of the fruit bristly.*—Low rich woods and thickets.

2. **G. Virginia'num**, L. Stem stout, bristly-hairy. Leaves nearly as in No. 1. *Petals white, shorter than the calyx. Receptacle of the fruit nearly smooth.*—Meadows and thickets; not common.

3. **G. strictum**, Ait. (YELLOW A.) Stem 2–3 feet high, rather hairy. Root-leaves interruptedly pinnate; stem-leaves 3–5 foliolate, leaflets obovate or ovate. *Petals yellow*, longer than the calyx. Receptacle of the fruit downy. Achenes tipped with the hooked style.—Dry thickets.

4. **G. riva'le**, L. (WATER or PURPLE AVENS.) *Petals purplish-yellow; calyx brown-purple.* Flowers nodding, but the fruiting heads upright. *The upper joint of the style feathery, persistent.* Stem simple, 2 feet high. Root-leaves lyrate; stem-leaves few, 3-foliolate, lobed.—Bogs and wet places.

5. **G. triflo'rum,** Pursh. Stem about a foot high, soft-hairy. Flowers 3 or more, on long peduncles, purple. Styles not jointed, feathery, *at least 2 inches long in the fruit.*—Dry hills and thickets; not common.

6. WALDSTEI'NIA, Willd. BARREN STRAWBERRY.

W. fragarioi'des, Tratt. A low plant, 4–6 inches high. Leaflets 3, broadly wedge-form, crenately toothed. Scapes several-flowered. Petals yellow, longer than the calyx.—Dry woods and hill-sides.

7. POTENTIL'LA, L. CINQUE-FOIL.

1. **P. Norve'gica,** L. (NORWAY CINQUE-FOIL.) Stem *erect, hairy,* branching above. *Leaves palmate, of 3 leaflets;* leaflets obovate-oblong, coarsely serrate. Flowers in cymose clusters. Petals pale yellow, small, *not longer than the sepals.*—Fields and low grounds.

2. **P. paradox'a,** Nutt., a plant of spreading or decumbent habit, with *pinnate leaves of 5–9 leaflets,* solitary flowers, *small petals,* and achenes with an appendage at the base, occurs along the south-western shore of Lake Ontario.

3. **P. Canaden'sis,** L. (CANADA C.) Stem prostrate or ascending, silky-hairy. *Leaves palmate, of 5 leaflets,* the latter serrate towards the apex. Flowers solitary. Petals yellow, *longer than the sepals.*—Dry soil.

4. **P. argen'tea,** L. (SILVERY C.) Stem ascending, branched at the summit, *white-woolly.* Leaves palmate, of 5 leaflets, the latter deeply serrate towards the apex, *with revolute margins, and woolly beneath.* Petals yellow, longer than the sepals.—Dry fields and roadsides.

5. **P. argu'ta,** Pursh. Stem stout, 1–2 feet high, brownish-hairy. Leaves pinnate, of 3–9 oval serrate leaflets, downy underneath. Flowers in dense cymose clusters. Petals yellowish or cream-coloured, deciduous. Plant clammy above.—Dry thickets.

6. **P. Anseri'na,** L. (SILVER-WEED.) A low plant, *creeping with slender runners.* Leaves all radical, interruptedly pinnate; leaflets 9–19, serrate, green above, *silvery-silky beneath. Flowers solitary, on long scape-like peduncles,* bright yellow.—River and lake margins.

7. **P. frutico'sa**, L. (SHRUBBY C.) Stem erect, *shrubby*, 1–3 feet high, much branched. Leaves pinnate, of 5–7 leaflets, closely crowded, *entire*, silky, especially beneath. Flowers numerous, large, yellow, terminating the branches.—Bogs.

8. **P. tridenta'ta**, Ait., (THREE-TOOTHED C.) is common eastward towards the sea-coast. Stem 4–6 inches high. Leaves rigid, palmate, of 3 wedge-shaped leaflets, *3-toothed at the apex. Petals white.*

9. **P. palustris**, Scop. (MARSH FIVE-FINGER.) Stem ascending. Leaves pinnate, of 5–7 lanceolate, crowded, deeply serrate leaflets, whitish beneath. *Calyx an inch broad, dark purple inside. Petals purple.*—Bogs.

8. **FRAGA'RIA**, Tourn. STRAWBERRY.

1. **F. Virginia'na**, Ehrhart. *Achenes deeply imbedded in pits* on the surface of the fleshy receptacle; calyx erect after flowering. Leaflets firm.

2. **F. ves'ca**, L. *Achenes not sunk in pits*, but merely on the surface of the receptacle; calyx spreading. Leaflets thin.

9. **DALIBAR'DA**, L. DALIBARDA.

D. repens, L. (*Rubus Dalibarda*, L., in Macoun's Catalogue.) Stems tufted, downy. Whole plant with something of the aspect of a violet.—Low woods.

10. **RUBUS**, Tourn. BRAMBLE.

1. **R. odora'tus**, L. (PURPLE FLOWERING-RASPBERRY.) Shrubby, 3–5 feet high. Branches, peduncles, and calyx *clammy with glandular hairs. Flowers large and handsome, rose-purple.* Leaves large, broadly ovate, 3–5 lobed, the lobes acute, minutely toothed. *Fruit flat.*

2. **R. triflo'rus**, Richardson. (DWARF RASPBERRY.) Stems ascending or trailing, a foot high, not prickly. Leaflets 3–5, nearly smooth, rhombic-ovate, acute at both ends, doubly serrate. Peduncle usually 3-flowered. Petals white; sepals reflexed. Fruit red.—Cedar swamps.

3. **R. strigo'sus**, Michx. (WILD RED RASPBERRY.) *Stems upright, beset with stiff straight bristles.* Leaflets 3–5, oblong-ovate, pointed, cut-serrate, whitish beneath. *Fruit light red.*—Hill-sides and thickets.

4. **R. occidenta'lis**, L. (BLACK RASPBERRY.) *Stem glaucus, recurved, armed with hooked prickles.* Leaflets 3, ovate, pointed, coarsely serrate, white-downy beneath. Fruit purplish-black.—Borders of fields, especially where the ground has been burned over.

5. **R. villo'sus**, Ait. (HIGH BLACKBERRY.) Stem shrubby, furrowed, erect or reclining, armed with hooked prickles. Leaflets 3–5, unequally serrate, the terminal one conspicuously stalked. Lower surface of the leaflets *hairy and glandular.* Flowers racemed, numerous, large and white. *Fruit oblong, black.* Var. **frondosus** is smoother and less glandular. Var. **humifusus** is trailing and smaller, and the flowers are less numerous.—Borders of thickets.

6. **R. Canaden'sis**, L. (LOW BLACKBERRY. DEWBERRY.) Stem shrubby, *extensively trailing, slightly prickly.* Leaflets chiefly 3, oval or ovate-lanceolate, *nearly smooth*, sharply serrate. Flowers in racemes.—Thickets and rocky hills.

7. **R. his'pidus**, L., (RUNNING SWAMP BLACKBERRY) occurs occasionally in low meadows. Stem prostrate, with small reflexed prickles, sending up at intervals the short flowering shoots. Leaflets mostly 3, smooth and shining. Fruit of few grains, red or purple.

11. ROSA, Tourn. ROSE.

* *Styles separate; included within the calyx-tube.*

1. **R. Caroli'na**, L. (SWAMP ROSE.) Stem 4–8 feet high, erect, armed with *stout hooked prickles*, but no bristles. Leaflets 5–9, finely serrate. *Flowers in corymbs, numerous. Calyx and globular calyx-tube beset with glandular bristles.*—Wet places.

2. **R. lu'cida**, Ehrhart. (DWARF WILD ROSE.) Stem 1–2 feet high, armed with slender *almost straight* prickles, and bristles. Leaflets 5–9, finely serrate. *Peduncles 1–3-flowered. Calyx-teeth bristly, but the tube in fruit nearly smooth.*—Dry soil, or borders of swamps.

3. **R. blanda**, Ait. (EARLY WILD ROSE.) Stem 1–3 feet high, *Prickles few and scattered, straight.* Leaflets 5–7. *Peduncles 1–3-flowered. Calyx and fruit smooth*, the lobes of the calyx erect and connivent in fruit.—Dry woods and fields.

4. **R. rubigino'sa,** L. (SWEET-BRIER.) Stem tall. Prickles numerous, the larger hooked, the smaller awl-shaped. Leaflets 5–7, doubly serrate, *glandular beneath. Flowers mostly solitary.* Fruit *pear-shaped* or obovate.—Roadsides and fields.

** * Styles cohering in a protruding column, as long as the stamens.*

5. **R. setig'era,** Michx. *Stem climbing.* Prickles nearly straight. Leaflets 3–5, ovate. Petals deep rose-coloured, changing to white.—Borders of thickets and along fences; south-western Ontario.

12. CRATÆ'GUS, L. HAWTHORN.

1. **C. coccin'ea,** L. (SCARLET-FRUITED THORN.) A low tree, *glabrous.* Leaves rather *thin*, roundish-ovate, serrate, *on slender petioles.* Fruit bright red, ovoid, hardly edible.—Thickets.

2. **C. tomento'sa,** L. (BLACK OR PEAR THORN.) A tall shrub or low tree, *downy*, at least when young. Leaves *thickish*, oval or broadly ovate, finely serrate, on *margined petioles*, furrowed along the veins. Fruit globular or pear-shaped, larger than in No. 1, edible.—Thickets.

3. **C. Crus-galli,** L. (COCKSPUR THORN.) A shrub or low tree, *glabrous.* Leaves thick, *shining above, wedge-obovate*, finely serrate. *Petioles very short.* Fruit globular, bright red. Thorns very long.—Thickets.

13. PYRUS, L. PEAR. APPLE.

1. **P. corona'ria,** L. (AMERICAN CRAB-APPLE.) A small tree, with ovate serrate *simple leaves.* Flowers in umbel-like cymes. Styles woolly and cohering at the base. *Fruit a greenish apple.* —Chiefly west of Toronto.

2. **P. arbutifo'lia,** L. (CHOKE-BERRY.) A shrub, with obovate finely serrate *simple leaves.* Flowers in compound cymes. *Fruit berry-like*, nearly globular, *dark red or black.*—Swamps.

3. **P. America'na,** DC. (AMERICAN MOUNTAIN ASH.) A small tree, with *odd-pinnate leaves of 13–15 leaflets*, the latter lanceolate, taper-pointed, sharply serrate, bright green. *Fruit scarlet, berry-like.* Flowers in flat cymes.—Swamps and cool woods, northward.

14. AMELAN'CHIER, Medic. JUNE-BERRY.

A. Canaden'sis, Torr. and Gray. (SHADBUSH.) A shrub or small tree, with a purplish, berry-like, edible fruit. The variety

Botryapium has ovate-oblong leaves, very sharply serrate, and white flowers in long drooping racemes, the petals 4 times as long as the calyx. The variety **rotundifolia** has broader leaves and shorter petals, and 6–10-flowered racemes.

Order XXXIII. SAXIFRAGA'CEÆ. (Saxifrage F.)

Herbs or shrubs, distinguished from Rosaceæ chiefly in having opposite as well as alternate leaves, and usually no stipules; stamens only as many or twice as many as the (usually 5) petals; and the carpels fewer than the petals (mostly 2), and usually more or less united with each other. Stamens and petals generally inserted on the calyx.

Synopsis of the Genera.

1. **Ri'bes.** Shrubs, sometimes prickly, with alternate and palmately-veined and lobed leaves, which are plaited in the bud. Calyx 5-lobed, the tube adherent to the ovary (superior). Petals 5, small, inserted on the calyx. Stamens 5. Styles 2. *Fruit a many-seeded berry.*
2. **Parnas'sia.** Smooth herbs, with entire and chiefly radical leaves, and solitary flowers terminating the long scapes. Petals 5, large, *veiny, each with a cluster of sterile filaments at the base.* Proper stamens 5. Stigmas 4. Pod 4-valved. Calyx free from the ovary.
3. **Saxif'raga.** Herbs with *clustered root-leaves.* Flowers in close cymes. Calyx-lobes hardly adherent to the ovary. Petals 5. Stamens 10. *Fruit a pair of follicles,* slightly united at the base.
4. **Mitel'la.** Low and slender herbs, with round heart-shaped radical leaves, *those on the scape (if any) opposite.* Flowers in terminal racemes. Calyx 5-lobed, adherent to the base of the ovary. Petals 5, slender, *pinnatifid.* Stamens 10, *short.* Styles 2. Pod 2-beaked, but 1-celled.
5. **Tiarel'la.** Slender herbs, with radical heart-shaped leaves, and *leafless* scapes, bearing a simple raceme of flowers. Calyx bell-shaped, 5-parted. Petals 5, *entire.* Stamens 10, *long and slender.* Pod 2-valved, *the valves unequal.*
6. **Chrysople'nium.** Small and smooth herbs, with mostly opposite roundish leaves. Calyx-tube adherent to the ovary. *Petals none.* Stamens twice as many as the calyx-lobes (8-10), inserted on a conspicuous disk. Pod 2-lobed.

1. RI'BES, L. Currant. Gooseberry.

1. **R. Cynos'bati,** L. (Wild Gooseberry.) Stem with small thorns at the bases of the leaves, the latter downy, on slender petioles, roundish heart-shaped, 3–5-lobed. *Peduncles slender,* 2-3-flowered. *Berry covered with long prickles.*—Open woods and clearings.

2. **R. hirtel'lum,** Michx. (SMALL WILD GOOSEBERRY.) Stems with very short thorns or none. *Peduncles very short*, 1-2-flowered. *Berry small, smooth.*—Low grounds.

3. **R. lacus'tre,** Poir. (SWAMP GOOSEBERRY.) Shrubby. Young stems prickly, and thorny at the bases of the leaves. Leaves cordate, *deeply 3-5-lobed, the lobes deeply cut. Racemes 4-9-flowered, slender, nodding.* Fruit bristly.—Swamps and wet woods.

4. **R. flor'idum,** L. (WILD BLACK CURRANT.) *Stems and fruit without prickles or thorns. Leaves resinous-dotted*, sharply 3-5-lobed, doubly serrate. Racemes many-flowered, drooping. Calyx bell-shaped. *Fruit black*, smooth.—Woods.

5. **R. rubrum,** L. (WILD RED CURRANT.) A low shrub with straggling stems. Leaves obtusely 3-5-lobed. *Racemes from lateral buds separate from the leaf-buds*, drooping. Calyx flat. *Fruit red*, smooth.—Bogs and wet woods.

2. PARNAS'SIA, Tourn. GRASS OF PARNASSUS.

P. Carolinia'na, Michx. Petals sessile, very veiny. Sterile filaments 3 in each set. Leaves ovate or rounded, *usually only one low down on the stalk.* Flower an inch across.—Beaver meadows and wet banks.

3. SAXIF'RAGA, L. SAXIFRAGE.

S. Virginien'sis, Michx. (EARLY SAXIFRAGE.) Stem 4-9 inches high. Scape clammy. Leaves obovate, crenately toothed. Petals white, oblong, twice as long as the sepals.—Damp rocks along streams.

4. MITEL'LA, Tourn. MITRE-WORT. BISHOP'S-CAP.

1. **M. diphyl'la,** L. (TWO-LEAVED MITRE-WORT.) Stem hairy. Leaves cordate, 3-5-lobed, *those on the scape 2, opposite*, nearly sessile. Flowers white.—Rich woods.

2. **M. nuda,** L. (NAKED-STALKED M.) Stem small and delicate. Leaves kidney-shaped, *doubly crenate. Scape leafless*, few-flowered. *Flowers greenish.*—Deep woods, on moss-covered logs, etc.

5. TIAREL'LA, L. FALSE MITRE-WORT.

T. cordifo'lia, L. Scape leafless, 5-12 inches high. Leaves heart-shaped, sharply toothed, sparsely hairy above, downy beneath. Petals white, oblong.—Rich woods.

6. **CHRYSOPLE'NIUM**, Tourn. GOLDEN SAXIFRAGE.

C. America'num, Schwein. A low and delicate smooth herb, with spreading and forking stems. Flowers greenish-yellow, inconspicuous, nearly sessile in the forks. Shady wet places.

ORDER XXXIV. CRASSULA'CEÆ. (ORPINE FAMILY.)

Succulent herbs (except in one genus), chiefly differing from Saxifragaceæ in having *symmetrical flowers*, the sepals, petals, and carpels being the same in number, and the stamens either as many or twice as many.

1. **PEN'THORUM**, Gronov. DITCH STONE-CROP.

P. sedoi'des, Gronov. Not succulent. Sepals 5. Petals 5, if any; sometimes wanting. Stamens 10. *Pod 5-angled, 5-horned, and 5-celled.* Leaves scattered, lanceolate, acute at both ends. A homely weed, with greenish-yellow flowers in a loose cyme.—Wet places. (Parts of the flowers occasionally in sixes or sevens.)

2. **SEDUM**, Tourn. STONE-CROP. ORPINE.

S. acre, L. (MOSSY STONE-CROP.) Leaves very thick and succulent, crowded, very small. Petals yellow. A spreading moss-like plant, which has escaped from cultivation in many places.—Roadsides.

ORDER XXXV. HAMAMELA'CEÆ. (WITCH-HAZEL F.)

Tall shrubs, with alternate simple leaves, and deciduous stipules. Flowers in clusters or heads, often monœcious. Calyx 4-parted, adherent to the base of the ovary, the latter of 2 united carpels. Fruit a 2-beaked, 2-celled, woody pod, opening at the top. Petals 4, strap-shaped, inserted on the calyx. Stamens 8, 4 of them anther-bearing, the remainder reduced to scales. The only genus with us is

HAMAME'LIS, L. WITCH-HAZEL.

H. Virgin'ica, L. Leaves obovate or oval, crenate or wavy-toothed, pubescent. Flowers yellow, appearing late in autumn. —Damp woods, chiefly west of Toronto.

ORDER XXXVI. **HALORA'GEÆ.** (WATER-MILFOIL F.)

Aquatic or marsh plants, with small inconspicuous flowers, sessile in the axils of the leaves or bracts. Calyx-tube adherent to the ovary, the latter in one genus 4-lobed and 4-celled; in the other of a single carpel. Limb of the calyx minute or none. Petals 4, if any. Stamens 1–8. Fruit indehiscent, a single seed in each cell.

Synopsis of the Genera.

1. **Myriophyl'lum.** Flowers monœcious or polygamous, with the parts in fours. Stamens 4 or 8. Immersed leaves pinnately dissected into capillary divisions.
2. **Hippu'ris.** Flowers perfect. Stamen, style, and carpel *only one.* Leaves *entire,* linear, acute; in whorls of 8 or 12.

1. MYRIOPHYL'LUM, Vaill. WATER-MILFOIL.

1. **M. spica'tum,** L. *Stamens 8.* Bracts ovate, entire, *shorter than the flowers.* Leaves in whorls of 3 or 4. Flowers greenish, in terminal spikes. Stem very long.—Deep water.

2. **M. verticilla'tum,** L. *Stamens 8.* Leaves finely dissected and whorled as in No. 1. Bracts pectinate-pinnatifid, much longer than the flowers, and the spike therefore leafy. Stem 2–4 feet long.—Stagnant water.

3. **M. heterophyl'lum,** Michx. *Stamens 4.* Lower leaves dissected, in whorls of 4 or 5. Bracts ovate or lanceolate, finely serrate, crowded, the lower ones pinnatifid. Stem stout.—Stagnant or slow water.

2. HIPPU'RIS, L. MARE'S TAIL.

H. vulga'ris, L. A perennial aquatic, with jointed erect stem. —Muddy margins of ponds and streams.

ORDER XXXVII. **ONAGRA'CEÆ.** (EVENING-PRIMROSE F.)

Herbs, with perfect and symmetrical flowers, the parts of the latter in twos or fours. Calyx-tube adherent to the ovary, and usually prolonged above it. Petals and stamens inserted on the calyx. Style 1. Stigmas 2 or 4 or capitate. (See Part I, sections 44–47, for description of a typical plant.)

Synopsis of the Genera.

1. **Circæ'a.** *Petals 2, obcordate. Stamens 2.* Stigma capitate. Fruit *bur-like*, 1-2-seeded, beset with hooked bristles. Delicate low plants with opposite leaves and very small white flowers in racemes.
2. **Epilo'bium.** *Petals 4. Stamens 8.* Calyx-tube hardly prolonged beyond the ovary. Fruit a linear pod, many-seeded, *the seeds provided with tufts of downy hair.*
3. **Œnothe'ra.** *Petals 4. Stamens 8.* Stigma 4-lobed. *Flowers yellow.* Calyx-tube much prolonged. Pods cylindrical or club-shaped. *Seeds without tufts.*
4. **Ludwig'ia.** *Petals 4, or none. Stamens 4.* Calyx-tube not prolonged. Stigma capitate.

1. CIRCÆ'A, Tourn. Enchanter's Nightshade.

1. **C. Lutetia'na,** L. Stem 1–2 feet high. Leaves opposite, ovate, slightly toothed. *No bracts under the pedicels.* Fruit roundish, *bristly-hairy, 2-celled.*—Rich woods.

2. **C. alpi'na,** L. Stem *low* and delicate (3–8 inches). Leaves cordate, coarsely toothed. *Minute bracts under the pedicels.* Fruit *club-shaped, soft-hairy, 1-celled.*—Deep low woods.

2. EPILO'BIUM, L. Willow-herb.

1. **E. angustifo'lium,** L. (Great Willow-herb.) Stem 3–6 feet high, simple. Leaves lanceolate. Flowers purple, very showy, *in a terminal raceme or spike.* Stigma of 4 long lobes.—Newly-cleared land.

2. **E. palustre,** L., var. **lineare.** Stem 1–2 feet high, erect, slender, branching above, *hoary-pubescent.* Leaves linear, nearly entire. Flowers *small, corymbed* at the ends of the branches, purplish or white. Petals erect. Stigma club-shaped.—Bogs.

3. **E. molle,** Torr., is occasionally met with. It differs from No. 2 chiefly in having the leaves crowded and their points more obtuse. The petals are rose-coloured.—Bogs.

4. **E. colora'tum,** Muhl. Stem 1–2 feet high, *nearly smooth.* Leaves *lanceolate* or *ovate-lanceolate.* Flowers small, corymbed. Petals purplish, *deeply notched.*—Extremely common in wet places.

3. ŒNOTHE'RA, L. Evening Primrose.

1. **Œ. bien'nis,** L. (Common Evening Primrose.) *Stem 2–4 feet high,* hairy. Leaves ovate-lanceolate. Flowers yellow,

odorous, in a leafy spike, opening in the evening or in cloudy weather. Pods oblong, narrowing towards the top.—Waste places.

2. **Œ. pu'mila,** L. (Small E.) Stem low, *5–12 inches high*, smooth or nearly so. Leaves lanceolate or oblanceolate. Pods nearly sessile, club-shaped, *4-angled*. Flowers pale yellow, opening in sunshine.—River and lake margins.

3. **Œ. chrysan'tha,** Michx. Distinguished from the preceding by the orange-yellow flowers, and *pedicelled pods*, the latter scarcely wing-angled.—Along the Niagara river.

4. LUDWIG'IA, L. False Loosestrife.

L. palustris, Ell. (Water Purslane.) Stems creeping in the mud of ditches or river margins, smooth. Leaves opposite, tapering into a slender petiole. Flowers sessile, solitary, usually without petals. Pod 4-sided.

Order XXXVIII. MELASTOMA'CEÆ. (Melastoma F.)

Low herbs with opposite 3–5-ribbed leaves. Calyx-tube adherent to the ovary, the limb 4-cleft. Petals 4, showy, convolute in the bud. Stamens 8, with 1-celled anthers opening by a pore at the apex; these and the petals inserted on the calyx. Style and stigma 1. Pod 4-celled, many-seeded; seeds coiled. The only representative with us is

RHEXIA, L. Deer-Grass. Meadow-Beauty.

1. **R. Virginica,** L. Stem square, wing-angled. Leaves oval-lanceolate. Petals purple.—Shores of the Muskoka Lakes.

Order XXXIX. LYTHRA'CEÆ. (Loosestrife F.)

Herbs, or slightly woody plants, with opposite or whorled entire leaves, without stipules. Calyx enclosing, *but free from*, the ovary. Petals (mostly 5) and stamens (mostly 10) inserted on the calyx. Flowers axillary or whorled. Style 1. Stigma capitate. The only common representative genus with us is

NESÆ'A, Commerson, Juss. Swamp Loosestrife.

N. verticilla'ta, H.B.K. Stems curving, 2–6 feet long, 4–6-sided. Leaves lanceolate, mostly whorled. Flowers purple, in the axils of the upper leaves. Calyx bell-shaped, with 5–7 erect teeth, with supplementary projections between them. Stamens 10, exserted, 5 longer than the rest.—Swamps.

ORDER XL. CUCURBITA'CEÆ. (GOURD FAMILY.)

Herbs, climbing by tendrils. Flowers monœcious. Calyx-tube adherent to the 1–3-celled ovary. Corolla commonly more or less gamopetalous. Stamens usually 3, united by their tortuous anthers, and often also by the filaments. Leaves alternate, palmately lobed or veined.

Synopsis of the Genera.

1. **Si'cyos.** Flowers greenish-white, small; the staminate corymbed, the pistillate clustered in a head on a long peduncle. *Corolla 5-cleft*, with a spreading border. Style slender; stigmas 3. Ovary 1-celled. Fruit *dry and indehiscent*, prickly, bur-like in appearance.
2. **Echinocys'tis.** Flowers whitish, small; the staminate in long compound racemes, the pistillate in small clusters from the same axils. *Corolla 6-parted.* Stigma broad, almost sessile. Ovary 2-celled, 4-seeded. Fruit fleshy, becoming dry, clothed with weak prickles.

1. SI'CYOS, L. STAR CUCUMBER.

S. angula'tus, L. A clammy-hairy weed in damp yards. Leaves roundish heart-shaped, 5-angled or lobed.

2. ECHINOCYS'TIS, Torr. and Gray. WILD BALSAM-APPLE.

E. loba'ta, Torr. and Gray. Climbing high about dwellings. Leaves deeply and sharply 5-lobed. The oval fruit 2 inches long.

ORDER XLI. FICOI'DEÆ. (ICE-PLANT FAMILY.)

A miscellaneous group, embracing plants formerly included in Caryophyllaceæ and Portulacaceæ; differing, however, from true representatives of these in having *partitions in the ovary.* Petals wanting in our genus.

MOLLU'GO, L. CARPET-WEED.

M. verticilla'ta, L. A prostrate much-branched herb, growing in patches. Leaves spathulate, apparently verticillate. Flowers on long axillary pedicels, clustered into a sort of umbel. Sepals 5, white inside. Petals none. Stamens mostly 3. Styles

3. Pod 3-celled, 3-valved, loculicidal, the partitions breaking away from the many-seeded axis.—Mostly in south-western Ontario.

ORDER XLII. UMBELLIF'ERÆ. (PARSLEY FAMILY.)

Herbs with small *flowers mostly in compound umbels.* Calyx-tube grown fast to the surface of the ovary ; calyx-teeth minute or none. The 5 petals and 5 stamens inserted on a disk which crowns the ovary. Styles 2. Fruit dry, 2-seeded. Stems hollow. Leaves usually much cut. (See Part I., Chapter VII., for description of a typical flower.)

Synopsis of the Genera.

§ 1. *Seeds flat (not hollow) on the inner face.*

1. **Hydrocot'yle.** *Umbels simple, or one springing from the summit of another*, axillary. Flowers white. Stem slender and creeping. Leaves round-kidney-shaped.

2. **Sanic'ula.** *Umbels irregular* (or compound), the *greenish flowers capitate* in the umbellets. Leaves palmately lobed or parted. Fruit globular, covered with hooked prickles.

(*In the Genera which follow, the umbels are regularly compound.*)

3. **Dau'cus.** Stem bristly. Leaves twice- or thrice-pinnate, or pinnatifid. Bracts of the involucre pinnatifid, very long. Fruit ribbed, the *ribs bristly.*

4. **Heracle'um.** *Stem 3–4 feet high, woolly* and grooved. Leaves 1–2-ternately compound. *Flowers white*, the outer corollas larger than the others. *Fruit wing-margined at the junction of the carpels*, very flat. Carpels 5-ribbed on the back.

5. **Pastina'ca.** *Stem smooth*, grooved. Leaves pinnate. *Flowers yellow, all alike.* Fruit as in No. 4.

6. **Archem'ora.** Stem smooth. Leaves pinnate, of 3–9 rather narrow leaflets. *Flowers white.* Fruit broadly winged, flat, 5-ribbed on the back.

7. **Archangel'ica.** Stem smooth, stout, purple. Leaves 2–3-ternately compound. *Flowers greenish-white.* Fruit smooth, flattish on the back, *double-wing-margined*, each carpel with 3 ribs on the back.

8. **Conioseli'num.** Stem smooth. Leaves finely 2–3-pinnately compound, the petioles inflated. *Flowers white.* Fruit *doubly wing-margined*, and with *3 narrow wings on the back of each carpel.*

9. **Thaspium.** Stem smooth. Leaves 1–2-ternately divided. *Flowers deep yellow.* Fruit not flattened, *10-winged or ribbed.*

10. **Zizia.** Stem slender, smooth and glaucous. Leaves 2–3-ternately compound. *Flowers yellow.* Rays of the umbel long and slender. *Fruit contracted at the junction of the carpels; the carpels narrowly 5-ribbed.*

11. **Cicu'ta.** Stem streaked with purple, stout. Leaves *thrice compound. Flowers white.* Fruit a little contracted at the sides, *the carpels strongly 5-ribbed.*

12. **Sium.** Stem grooved. Leaves simply *pinnate. Flowers white.* Fruit as in No. 10.

13. **Cryptotæ'nia.** Stem smooth. *Leaves 3-foliolate. The umbels with very unequal rays.* Flowers white. Fruit nearly as in Nos. 10 and 11.

§ 2. *Inner face of each seed hollowed lengthwise.*

14. **Osmorrhi'za.** Leaves large, 2–3-ternately compound. Flowers white. Fruit linear-oblong, angled, tapering downwards into a stalk-like base. Ribs of the carpels bristly upwards.

15. **Co'nium.** Leaves large, decompound. Flowers white. Fruit ovate, flattened at the sides, 5-ribbed, *the ribs wavy.*

§ 3. *Inner face of each seed curved inwards at top and bottom.*

16. **Erige'nia.** Stem low and smooth. Leaves 2–3-ternately divided. *Fruit twin.* Carpels nearly kidney-form. Umbels 3-rayed, small. Flowers white.

1. HYDROCOT'YLE, Tourn. WATER PENNYWORT.

H. America'na, L. Stem spreading and creeping, very slender. Leaves kidney-shaped, crenate, slightly lobed. Umbels 3–5-flowered, inconspicuous, in the axils of the leaves.—Shady wet places.

2. SANIC'ULA, Tourn. SANICLE. BLACK SNAKEROOT.

1. **S. Canaden'sis,** L. *Leaves 3–5-parted. A few staminate flowers* among the perfect ones, and on *very short pedicels.* Styles shorter than the prickles of the fruit.—Low rich woods, not so common as the next.

2. **S. Marilan'dica,** L. *Leaves 5–7-parted.* Staminate flowers numerous, and *on slender pedicels.* Styles long, recurved.—Rich woods.

3. DAU'CUS, Tourn. CARROT.

D. Caro'ta, L. (COMMON CARROT.) Found wild occasionally in old fields. In fruit the umbel becomes hollow like a bird's nest.

4. HERACLE'UM, L. COW PARSNIP.

H. lana'tum, Michx. Umbels large and flat. Petioles of the leaves spreading and sheathing. Leaves very large; leaflets broadly heart-shaped, deeply lobed. Low wet meadows.

5. **PASTINA'CA**, Tourn. PARSNIP.

P. sati'va, L. (*Peucedanum sativum*, Benth. and Hook., in Macoun's Catalogue.) (COMMON PARSNIP.) Found wild in old fields and along roadsides. Leaflets shining above.

6. **ARCHEM'ORA**, DC. COWBANE.

A. rig'ida, DC. Calyx 5-toothed. Involucre almost none; involucels of many small bractlets.—Sandy swamps, south-western Ontario.

7. **ARCHANGEL'ICA**, Hoffm. ARCHANGELICA.

A. atropurpu'rea, Hoffm. (GREAT ANGELICA.) Stem very tall (4–6 feet) and stout, dark purple. Whole plant strong-scented. Petioles much inflated at the base.—Marshes and low river-banks.

8. **CONIOSELI'NUM**, Fischer. HEMLOCK-PARSLEY.

C. Canadense, Torr. and Gr. (*Selinum Canadense*, Michx., in Macoun's Catalogue.) Stem 2–4 feet high. Petioles much inflated. Leaflets of the involucels awl-shaped.—Swamps.

9. **THASPIUM**, Nutt. MEADOW-PARSNIP.

T. au'reum, Nutt. Stem 1–2 feet high, angular-furrowed. Leaflets oblong-lanceolate, sharply serrate. *Fruit with 10 winged ridges*, or in var. **apterum** *with 10 ribs.*—Dry or rich woods.

10. **ZIZIA**, DC. ZIZIA.

Z. integer'rima, DC. (*Pimpinella integerrima*, Benth. and Hook., in Macoun's Catalogue.) Stem slender, 1–2 feet high. Involucels none. Plant strong-scented.—Rocky hill-sides.

11. **CICU'TA**, L. WATER-HEMLOCK.

1. **C. macula'ta,** L. (SPOTTED COWBANE. BEAVER POISON.) Stem 3–6 feet high, purplish, smooth. Leaflets *ovate-lanceolate, coarsely serrate*, pointed.—Swamps and low grounds.

2. **C. bulbif'era,** L., is easily distinguished from No. 1 by bearing *clusters of bulblets* in the axils of the upper leaves. The leaflets, also, are *linear.*—Swamps and low grounds.

12. **SIUM**, L. Water-Parsnip.

S. lineare, Michx. (*S. cicutæfolium*, Gmelin, in Macoun's Catalogue.) Stem 2–3 feet high, furrowed. Leaflets varying from linear to oblong, sharply pointed and serrate.—Borders of marshes, usually in the water.

13. **CRYPTOTÆ'NIA**, DC. Honewort.

C. Canadensis, DC. Stem 1–2 feet high, slender. Leaflets large, ovate, doubly serrate. No involucre.—Rich woods and thickets.

14. **OSMORRHI'ZA**, Raf. Sweet Cicely.

1. **O. longis'tylis**, DC. (Smoother Sweet Cicely.) Stem reddish, nearly smooth. Leaflets sparingly pubescent, short-pointed *Styles slender, nearly as long as the ovary*, recurved.—Rich woods.

2. **O. brevis'tylis**, DC. (Hairy Sweet Cicely.) Whole plant hairy. Leaflets taper-pointed. *Styles very short, conical.* Rich woods.

15. **CO'NIUM**, L. Poison Hemlock.

C. macula'tum, L. Stem smooth, spotted. Leaflets lanceolate, pinnatifid, pale green, with an offensive odour when bruised. Involucels one-sided. Inner face of the seed marked with a deep groove.—Waste places.

16. **ERIGE'NIA**, Nutt. Harbinger-of-Spring.

E. bulbo'sa, Nutt. Stem 4–6 inches high, from a tuber deep in the ground, producing 2 leaves, the lower radical. Leaflets much incised. Flowers few.—Alluvial soil.

Order XLIII. ARALIA'CEÆ. (Ginseng Family.)

Herbs (with us) differing from the last Order chiefly in having, as a rule, *more than 2 styles*, and the *fruit a drupe*. The umbels, also, are either single, or corymbed, or panicled. Flowers often polygamous. The only Canadian genus is

ARA'LIA, Tourn. Ginseng. Wild Sarsaparilla.

* *Umbels corymbed or panicled. Petals, stamens, and styles each 5. Fruit black or dark-purple.*

1. **A. racemosa**, L. (Spikenard.) *Umbels in a large compound panicle.* Stem 2–3 feet high, widely branching. Leaves

very large and decompound; leaflets ovate-cordate, doubly serrate. Roots aromatic.—Rich woods.

2. **A. his'pida,** Michx. (BRISTLY SARSAPARILLA. WILD ELDER.) Stem 1–2 feet high, *bristly*, leafy, somewhat shrubby at the base. *Umbels 2–7, corymbed.* Leaves twice-pinnate. Leaflets sharply serrate. Fruit black.—Rocky or sandy woods.

3. **A. nudicau'lis,** L. (WILD SARSAPARILLA.) True stem very short, sending up a naked scape bearing 3 or 4 long-peduncled umbels at the summit, and one long-petioled leaf, ternately divided, and with 5 leaflets on each division. Root horizontal, aromatic.—Rich woods.

* * *Umbel single, on a long peduncle. Styles 2 or 3.*

4. **A. quinquefo'lia,** Decaisne. (GINSENG.) Leaves in a whorl of 3 at the summit of the stem, the latter a foot high. *Leaflets mostly 5, long-stalked.*—Rich woods.

5. **A. trifo'lia,** Decaisne. Stem 4–6 inches high. Leaves in a whorl of 3 at the summit, but *the leaflets usually only 3, and sessile.*—Rich woods.

ORDER XLIV. CORNA'CEÆ. (DOGWOOD FAMILY.)

Shrubs or trees (rarely herbs) with simple leaves. Calyx-tube adherent to the 1–2-celled ovary, the limb of the calyx inconspicuous. Petals 4. Stamens 4, all epigynous. Style 1; stigma flat or capitate. Fruit a 1–2-seeded drupe. Flowers in cymes or in close heads, surrounded by a showy involucre resembling a corolla. The only common Canadian genus is

CORNUS, Tourn. CORNEL. DOGWOOD.

* *Flowers in a close head, surrounded by a showy involucre of 4 white bracts. Fruit red.*

1. **C. Canadensis,** L. (BUNCH-BERRY.) Stem simple, 5 or 6 inches high. Upper leaves crowded and apparently whorled, ovate, the lower scale-like. Leaves of the involucre ovate.—Rich woods.

2. **C. florida,** L. (FLOWERING DOGWOOD.) A small tree, with opposite ovate pointed leaves. Leaves of the involucre notched at the apex.—Rocky woods. South-westward.

* * *Flowers (white) in flat cymes. No involucre. Fruit blue or white.*

3. **C. circina'ta,** L'Her. (ROUND-LEAVED DOGWOOD.) A shrub, 4–6 feet high, with *greenish warty-dotted branches.* Leaves opposite, *broadly oval,* white-woolly beneath. Fruit light blue.—Rich woods.

4. **C. seric'ea,** L. (SILKY CORNEL.) A large shrub, with *purplish branches.* Leaves opposite, narrowly ovate or oblong, silky beneath. Branchlets often rusty. Fruit light blue. Distinguished from No. 3 by the colour of the branches and the much smaller leaves.—Low wet grounds.

5. **C. stolonif'era,** Michx. (RED-OSIER DOGWOOD.) A shrub forming clumps by the production of suckers or stolons, 3–6 feet high. *Branches bright red-purple, smooth.* Leaves opposite, ovate, roughish, whitish beneath. Fruit white or whitish.—Low wet grounds.

6. **C. panicula'ta,** L'Her. (PANICLED CORNEL.) A shrub 4–8 feet high, with erect, gray, and smooth branches. Flowers white, very numerous. Leaves opposite, ovate-lanceolate, taper-pointed. Cymes convex. Fruit white.—Thickets and river-banks.

7. **C. asperifo'lia,** Michx., (ROUGH-LEAVED DOGWOOD) is reported by Macoun as common on Point Pelee. Branches brownish, the branchlets rough-pubescent. Leaves opposite, rather small, oblong or ovate; rough above, downy beneath. Fruit bluish.

8. **C. alternifo'lia,** L. (ALTERNATE-LEAVED CORNEL.) A large shrub or small tree, with *alternate greenish branches streaked with white. Leaves mostly alternate,* oval, acute at each end, crowded at the ends of the branches. Flowers yellowish, in loose cymes. Fruit deep blue, on reddish stalks.—Thickets.

II. GAMOPET'ALOUS DIVISION.

Embracing plants with both calyx and corolla, the latter with the petals united (in however slight a degree).

ORDER XLV. CAPRIFOLIA'CEÆ. (HONEYSUCKLE F.)

Shrubs, rarely herbs, with the calyx-tube adherent to the ovary, the corolla borne on the ovary, and the stamens on the tube of the corolla. Leaves opposite and without stipules, but some species of **Vibur'num** have appendages resembling stipules. Fruit a berry, drupe, or pod.

Synopsis of the Genera.

* *Corolla tubular, sometimes 2-lipped. Style slender.*

1. **Linnæ'a.** A trailing or creeping herb, with evergreen oval crenate leaves and slender scape-like peduncles which fork at the top into 2 pedicels, each of which bears a pair of nodding narrowly bell-shaped purplish flowers. Stamens 4, 3 shorter than the others.
2. **Symphoricar'pus.** Upright branching shrubs, with oval entire short-petioled leaves. Flowers in interrupted spikes at the ends of the branches, rose-coloured. Corolla bell-shaped, 4-5-lobed, with as many stamens. Berries large and white, 4-celled, but only 2-seeded.
3. **Lonice'ra.** Upright or twining shrubs, with entire leaves. Corolla funnel-form, more or less irregular, *often with a projection on one side at the base.* Berry several-seeded.
4. **Diervil'la.** Low upright shrubs with ovate pointed serrate leaves. Calyx-tube tapering towards the top, the teeth slender. Flowers light yellow, peduncles mostly 3-flowered. Corolla funnel-form, nearly regular. Pod slender, pointed.
5. **Trios'teum.** Coarse herbs. Lobes of the calyx leaf-like. Flowers brownish-purple, sessile in the axils of the leaves. Corolla bulging at the base. Fruit a 3-seeded orange-coloured drupe.

* * *Corolla rotate or urn-shaped, regular, 5-lobed. Flowers white, in broad cymes.*

6. **Sambu'cus.** Upright shrubs with pinnate leaves, the leaflets serrate. Stigmas 3. Fruit purple or red, a juicy berry-like drupe, with 3 seed-like stones.
7. **Vibur'num.** Upright shrubs with simple leaves, and white flowers in compound cymes. Fruit a 1-seeded drupe.

1. LINNÆ'A, Gronov. TWIN-FLOWER.

L. borea'lis, Gronov.—Cool mossy woods and swamps.

2. SYMPHORICAR'PUS, Dill. SNOWBERRY.

S. racemo'sus, Michx. (SNOWBERRY.) Corolla bearded inside. Flowers in a rather loose spike. Var. **pauciflo'rus**, Robbins, is low, diffusely branched, and spreading, with two or three flowers only, in the axils of the uppermost leaves.—Dry rocky hill-sides.

3. LONICE'RA, L. HONEYSUCKLE. WOODBINE.

1. **L. parviflo'ra**, Lam. (*L. glauca*, Hill, in Macoun's Catalogue.) (SMALL HONEYSUCKLE.) *Twining shrub*, 2-4 feet high,

with smooth leaves which are glaucous beneath, the upper ones connate-perfoliate; corolla yellowish-purple.—Rocky banks.

2. **L. hirsu'ta,** Eaton. (HAIRY HONEYSUCKLE.) Stem *twining high.* Leaves *not glaucous, very large, downy-hairy,* the upper ones connate-perfoliate. Flowers in close whorls; corolla greenish-yellow, clammy-pubescent.—Damp thickets.

3. **L. cilia'ta,** Muhl. (FLY-HONEYSUCKLE.) A branching upright shrub, with *thin oblong-ovate ciliate leaves.* Peduncles axillary, filiform, shorter than the leaves, *each 2-flowered at the top.* Corolla greenish-yellow, *almost spurred at the base.* The two berries separate.—Damp woods.

4. **L. oblongifo'lia,** Muhl. (SWAMP FLY-HONEYSUCKLE). A shrub with upright branches, and *oblong leaves. Peduncles long and slender, 2-flowered.* Corolla deeply 2-lipped. Berries united at the base.—Swamps and low grounds.

4. DIERVIL'LA, Tourn. BUSH-HONEYSUCKLE.

D. trif'ida, Mœnch.—Rocky woods and clearings.

5. TRIOS'TEUM, L. FEVER-WORT.

T. perfolia'tum, L. A coarse herb, 2–4 feet high, soft-hairy. Leaves oval, narrowed at the base. Fruit orange-coloured.—Old clearings and thickets.

6. SAMBU'CUS, Tourn. ELDER.

1. **S. Canadensis,** L. (COMMON ELDER.) Shrub 5–10 feet high, in clumps. Leaflets 7–10, oblong. Cymes flat. Fruit black-purple.—Open grounds, and along streams.

2. **S. pubens,** Michx., (RED-BERRIED ELDER) may be distinguished from No. 1 by its warty bark, brown pith, 5–7 leaflets, convex or pyramidal cymes, and red berries.—Rocky woods.

7. VIBUR'NUM, L. ARROW-WOOD. LAURESTINUS.

1. **V. Lenta'go,** L. (SWEET VIBURNUM. SHEEP-BERRY.) A small tree, with *ovate finely-serrate pointed leaves,* with long and margined petioles. *Cyme sessile.* Fruit black.—Along streams.

2. **V. nudum,** L. (WITHE-ROD.) A smooth shrub with tall straight stems. Leaves thickish, entire or wavy-toothed, dotted beneath. *Cymes with short peduncles.* Fruit black.—Cold swamps.

3. **V. pubes'cens,** Pursh. (Downy Arrow-wood.) A straggling shrub, not more than 4 feet high, with small ovate coarsely serrate leaves, *the lower surface soft-downy*. Cymes small. Fruit oblong, dark-purple.—Rocky places.

4. **V. acerifo'lium,** L. (Maple-leaved A. Dockmackie.) A shrub 3–6 feet high, with greenish bark. Leaves 3-lobed, 3-ribbed, soft-downy beneath. Stipular appendages bristle-shaped. Cymes small, on long peduncles. Fruit red, becoming black.—Thickets and river-banks.

5. **V. Op'ulus,** L. (Cranberry-tree.) An upright shrub, 5–10 feet high, with strongly 3-lobed leaves, broader than long, the lobes spreading and pointed. Cymes peduncled. Marginal flowers of the cyme very large and neutral. Stipular appendages conspicuous. Fruit red, pleasantly acid.—Low grounds.

6. **V. lantanoi'des,** Michx. (Hobble-bush.) A straggling shrub with reclining branches. Leaves large, round-ovate, heart-shaped at the base, serrate, many-veined, the veins underneath and the stalks and branchlets very rusty-scurfy. Stipular appendages conspicuous. Cymes sessile, very broad and flat, with very conspicuous neutral flowers on the margin.—Moist woods.

Order XLVI. RUBIA'CEÆ. (Madder Family.)

Herbs or shrubs, chiefly distinguished from the preceding Order by the presence of stipules between the opposite entire leaves, or by the leaves being in whorls without stipules. Calyx superior. Stamens alternate with the (mostly 4) lobes of the corolla, and inserted on its tube. Ovary 2–4-celled.

Synopsis of the Genera.

1. **Ga'lium.** *Leaves in whorls. Slender weak herbs with square stems.* Calyx-teeth inconspicuous. Corolla 4-parted, wheel-shaped. Styles 2. Fruit twin, separating into two 1-seeded carpels.

2. **Cephalan'thus.** *Leaves opposite. Shrubs with the flowers in a globular peduncled head.* Lobes of calyx and corolla each 4. Style very slender, much protruded. Stigma capitate.

3. **Mitchel'la.** *Leaves opposite. Shining trailing evergreen herbs,* with flowers in pairs, *the ovaries united.* Lobes of calyx and corolla each 4, the corolla bearded inside. Style 1. Stigmas 4. Fruit a red 2-eyed berry.

4. **Housto'nia.** *Leaves opposite. Low and slender erect herbs*, with the flowers in small terminal clusters. Lobes of calyx and corolla each 4. Style 1. Stigmas 2.

1. GA'LIUM, L. BEDSTRAW. CLEAVERS.

1. **G. Apari'ne,** L. (CLEAVERS. GOOSE-GRASS.) *Leaves about 8 in a whorl*, lanceolate, rough-margined. Peduncles 1–2-flowered, *axillary. Fruit covered with hooked prickles.*—Low grounds.

2. **G. triflo'rum,** Michx. (SWEET-SCENTED BEDSTRAW.) *Leaves chiefly 6 in a whorl*, elliptical-lanceolate, bristle-pointed. Peduncles 3-flowered, *terminating the branches. Fruit covered with hooked prickles.*—Woods.

3. **G. pilo'sum,** Ait. Leaves in whorls of 4, *hairy, oval.* Peduncles twice- or thrice-forked.—Southwestern Ontario.

4. **G. lanceola'tum,** Torr. (WILD LIQUORICE.) *Leaves all in whorls of 4 each*, lanceolate, *tapering at the apex*, more or less 3-nerved. Peduncles mostly once-forked. Flowers few or several, remote. Fruit covered with hooked prickles.

5. **G. circæ'zans,** Michx., is similar to No. 3, but the leaves are *obtuse* instead of tapering.—Woods.

6. **G. asprel'lum,** Michx. (ROUGH BEDSTRAW.) Leaves in whorls of 6, or 4 or 5 on the branchlets, elliptical-lanceolate, very rough on the edges and midrib. Stem weak, 3–5 feet high, leaning upon and clinging to bushes by its rough edges. *Flowers numerous in panicled clusters.* Fruit not rough.—Thickets.

7. **G. trif'idum,** L. (SMALL BEDSTRAW.) Leaves in whorls of 4–6. Stem 6–18 inches high, roughened on the edges, as are the leaves usually. *Flowers few, not panicled. Parts of the flowers generally in threes.* Fruit smooth. Var. **latifolium,** Torr., is easily known by its broad leaves and widely branching stems.—Low grounds and swamps.

8. **G. borea'le,** L. (NORTHERN BEDSTRAW.) *Leaves in whorls of 4*, linear-lanceolate, 3-nerved. Flowers very numerous, crowded in a narrow and compact terminal panicle. Stem erect and rigid, 1–3 feet high.—Rocky thickets and river-banks.

3. CEPHALAN'THUS, L. BUTTON BUSH.

C. occidenta'lis, L. A smooth shrub growing in swamps, with ovate petioled pointed leaves, which are opposite or in whorls of 3. Easily recognized by the globular head of white flowers.

4. **MITCHEL'LA**, L. PARTRIDGE BERRY.

M. repens, L.—Common in dry woods. Leaves round-ovate, shining, sometimes with whitish lines.

5. **HOUSTO'NIA**, L. HOUSTONIA.

H. purpu'rea, L. Stems tufted, 3–6 inches high. Leaves varying from roundish-ovate to lanceolate, 3–5-ribbed, sessile.—Woodlands.

ORDER XLVII. VALERIANA'CEÆ. (VALERIAN F.)

Herbs with opposite exstipulate leaves, and small cymose flowers. Calyx-tube adherent to the ovary, the latter 3-celled, but *only one of these fertile.* Stamens 1–3, *fewer than the lobes of the corolla.* Style slender. Stigmas 1–3. The only common genus is

VALERIA'NA, Tourn. VALERIAN.

1. **V. sylvat'ica,** Richards. (*V. dioica*, var. **uliginosa,** Torr. and Gray, in Macoun's Catalogue.) Not uncommon in cedar-swamps. *Root fibrous. Calyx-limb consisting of several bristles rolled inwards in the flower, but expanding in fruit.* Corolla gibbous at the base. Stamens 3. Root-leaves ovate or oblong, entire; stem-leaves pinnate, leaflets 5–11. Stem erect, striate, 1–2 feet high.

2. **V. ed'ulis,** Nutt. *Root spindle-shaped, large.* Flowers in a long and narrow interrupted panicle, nearly diœcious. Stem-leaves deeply pinnatifid.—Low grounds, western Ontario.

ORDER XLVIII. DIPSA'CEÆ. (TEASEL FAMILY.)

Herbs with the flowers in heads, surrounded by a many-leaved involucre, as in the next Family, *but the stamens are distinct.* Leaves opposite. Represented in Canada by the genus

DIP'SACUS, Tourn. TEASEL.

D. sylves'tris, Mill. (WILD TEASEL.) A stout coarse prickly plant, not unlike a thistle in appearance. Flowers in oblong very dense heads, bluish. Corolla 4-cleft. Stamens 4, on the corolla. Bracts among the flowers terminating in a long awn. Leaves generally connate.—Roadsides and ditches. Rather common in the Niagara district, but found also elsewhere.

ORDER XLIX. COMPOSITÆ. (COMPOSITE FAMILY.)

Flowers in a dense head on a common receptacle, and surrounded by an involucre. Calyx-tube adherent to the ovary, its limb either obsolete or forming a pappus of few or many bristles or chaffy scales. Corolla either tubular or with one side much prolonged (strap-shaped or ligulate). Stamens usually 5, on the tube of the corolla, their anthers united (syngenesious). Style 2-cleft. (See Part I., sections 60–62, for examination of a typical flower.)

The heads of flowers present some variety of structure. *All* the flowers of a head may be tubular ; or only the central ones or *disk-flowers*, as they are then called, may be tubular, whilst those around the margin, then known as *ray-flowers*, are ligulate or strap-shaped. Or again, *all* the flowers may be strap-shaped. It is not unusual also to find a mixture of perfect and imperfect flowers in the same head.

The bracts which are often found growing on the common receptacle among the florets are known as the *chaff*. When these bracts are entirely absent the receptacle is said to be *naked*. The leaves of the involucre are called its *scales*.

Artificial Synopsis of the Genera.

SUBORDER I. TUBULIFLORÆ.

Heads either altogether without strap-shaped corollas, or the latter, if present, forming only the outer circle (the *ray*). Ray-flowers, when present, *always without stamens*, and often without a pistil also.

A. Ray-flowers entirely absent.

* Scales of the involucre in many rows, *bristly-pointed, or fringed.*

+ *Florets all perfect.*

1. **Cir'sium.** *Leaves and scales of the involucre prickly.* Pappus of long plumose bristles. Receptacle with long soft bristles among the florets. Flowers reddish-purple.

2. **Onopor'don.** *Leaves and scales of the involucre prickly.* Heads much as in Cirsium, but the *receptacle naked*, and deeply honeycombed. Pappus of long bristles, *not* plumose. Stem winged by the decurrent bases of the leaves. Flowers purple.

3. **Lap'pa.** *Leaves not prickly, but the scales of the globular involucre tipped with hooked bristles.* Pappus of many short rough bristles. Receptacle bristly. Flowers purple.

+ + *Marginal florets sterile, and their corollas much larger than the others, forming a kind of false ray.*

4. **Centaure'a.** Leaves not prickly. *Scales of the involucre fringed.* Pappus very short. Receptacle bristly. Flowers blue.

+ + + *Sterile and fertile florets in separate heads,* i.e., *monœcious. Fruit a completely closed involucre (usually bristly) containing only one or two florets, these heads sessile in the axils of the bracts or upper leaves. Sterile heads with more numerous florets in flattish involucres, and forming racemes or spikes. Pappus none.*

5. **Xan'thium.** Fertile florets only 2 together in burs with hooked prickles, clustered in the axils. Sterile heads in short spikes above them, the scales of their involucres in one row only, *but not united together.*

6. **Ambro'sia.** Fertile florets single, in a closed involucre armed with a few spines at the top. Sterile heads in racemes or spikes above, the scales of their involucres in a single row and *united into a cup.*

* * Scales of the involucre without bristles of any kind.

+ Marginal florets without stamens.

++ *Pappus none or minute. Receptacle naked. Very strong-scented herbs.*

7. **Tanace'tum.** Flowers yellow, in numerous corymbed heads. Scales of the involucre dry, imbricated. Pappus 5-lobed. Leaves dissected.

8. **Artemis'ia.** Flowers yellowish or dull purplish, in numerous small heads which are panicled or racemed. Scales of the involucre with dry and scarious margins, imbricated. Hoary herbs.

++ ++ *Pappus of all the florets bristly. Receptacle naked.*

9. **Erechthi'tes.** Flowers whitish. *Scales of the involucre in a single row, linear, with a few bractlets at the base.* Corolla of the marginal florets very slender. Pappus copious, of fine soft white hairs. Heads corymbed. Erect and coarse herbs.

10. **Gnapha'lium.** Flowers whitish or yellowish. Scales of the involucre yellowish-white, in many rows, dry and scarious, woolly at the base. Outer corollas slender. Pappus a single row of fine rough bristles. Flocculent-woolly herbs.

11. **Antenna'ria.** Very much like Gnaphalium in appearance, being white-woolly, *but the heads are usually diœcious,* and the bristles of the pappus thicker in the sterile florets.

+ + All the florets in the head perfect.

11. **Antenna'ria,** with diœcious heads, may be looked for here. See previous paragraph.

Bidens. One or two species have no rays. See No. 25.

Sene'cio. One species is without rays. See No. 14.

12. **Lia'tris.** Flowers handsome, rose-purple. Receptacle naked. Pappus of long and slender bristles, plumose or rough. Achenes slender, 10-ribbed. Lobes of the corolla slender. Stem wand-like, leafy *Leaves narrow or grass-like.*

13. **Eupato'rium.** Flowers white or purple. Receptacle naked. Pappus of slender hair-like bristles, smooth or nearly so. Achenes 5-angled. Heads in corymbs. Leaves whorled, or connate, or opposite.

B. Rays or strap-shaped corollas round the margin of the head.

* *Pappus of hair-like bristles. Receptacle naked.*

14. **Sene'cio.** Rays yellow, or in one species *none.* Scales of the involucre in a single row, or with a few bractlets at the base. Pappus very fine and soft. Heads corymbose. Leaves alternate.

15. **In'ula.** Rays yellow, numerous, very narrow, in a single row. Outer scales of the involucre leaf-like. *Anthers with two tails at the base.* Stout plants, with large alternate leaves which are woolly beneath.

16. **Solida'go.** Rays yellow, few, as are also the disk-florets. Involucre oblong, scales of unequal lengths, appressed. Achenes many-ribbed. Heads small, in compound racemes, or corymbs. Stems usually wand-like. Leaves alternate.

17. **Nardos'mia.** Rays whitish or purplish. Heads in a corymb, fragrant. Scales of the involucre in a single row. Heads somewhat diœcious, the staminate with one row of pistillate ray-flowers, the pistillate with ray-flowers in many rows. *Woolly herbs,* with large leaves, *all radical,* and sheathing scaly bracts on the scape.

18. **Aster.** Rays white, purple, or blue, *never yellow,* but the *disk* generally yellow. Pappus a *single row* of numerous fine roughish bristles. Achenes flattish. Heads corymbed or racemose. Flowering in late summer.

19. **Erig'eron.** Rays and disk as in Aster, *but the rays very narrow, and usually in more than one row.* Scales of the involucre in one or two rows, nearly of equal length. Pappus of long bristles *with shorter ones intermixed.* Heads corymbed or solitary. Leaves generally sessile.

20. **Diplopap'pus.** Rays white, long. Disk-florets yellow. Scales of the involucre 1-nerved. *Pappus double,* the outer row of short stiff bristles. Heads small, corymbed.

* * *Pappus not of hair-like bristles, but either altogether wanting or consisting of a few chaffy scales or teeth, or only a minute crown.*

+ Receptacle naked.

21. **Hele'nium.** Rays yellow, wedge-shaped, 3–5-cleft at the summit. Scales of the involucre reflexed, awl-shaped. Pappus of 5–8 chaffy scales, 1-nerved, the nerve usually extending into a point. Leaves alternate, decurrent on the angled stem. Heads corymbed, showy.

22. **Leucan'themum.** Rays white; disk yellow. Disk-corollas with a flattened tube. *Pappus none.* Heads single.

+ + Receptacle chaffy.

23. **Maru'ta.** Rays white, *soon reflexed;* disk yellow. *Ray-florets neutral.* Pappus none. Receptacle conical, more or less chaffy. Herbs with strong odour.

24. **Rudbeck'ia.** Rays yellow, usually long; *disk dark-purple, or in one species greenish-yellow.* Scales of the involucre leaf-like. Receptacle conical. Pappus none, or only a minute crown. Ray-florets neutral.

25. **Helian'thus.** Rays yellow, neutral. Receptacle flattish or convex. Chaff persistent, and *embracing the 4-sided achenes.* Pappus deciduous, of 2 thin scales. Stout coarse herbs.

26. **Bidens.** Rays yellow, few; but 2 species are without rays. Scales of the involucre in 2 rows, the outer large and leaf-like. Ray-florets neutral. *Achenes crowned with 2 or more stiff awns which are barbed backward.*

27. **Heliop'sis.** Rays yellow, 10 or more, pistillate. Scales of the involucre in 2 or 3 rows, the outer leaf-like. Receptacle conical; chaff linear. Achenia smooth, 4-angled. Pappus none.

28. **Achille'a.** Rays white (occasionally pinkish), few. Receptacle flattish. Pappus none. Achenes margined. Heads small, in flat corymbs. Leaves very finely dissected.

29. **Polym'nia.** Rays whitish-yellow, wedge-form, shorter than the involucre, few in number. Scales of the involucre in 2 rows, the outer leaf-like, the inner small, and partly clasping the achenes. Pappus none. Coarse clammy herbs with an unpleasant odour.

30. **Sil'phium.** Easily known by its stout square stem, and the upper connate leaves forming a sort of cup. Flowers yellow. Achenes broad and flat.

SUBORDER II. LIGULIF'LORÆ.

Corolla strap-shaped in all the florets of the head. All the florets perfect. Herbs with milky juice, and alternate leaves.

31. **Cyn'thia.** Flowers yellow. Pappus double, the outer short, of many minute chaffy scales, the inner of many long capillary bristles. Low perennials with single showy heads on scapes.

32. **Lamp'sana.** Flowers yellow, 8–12 in a head. Scales of the involucre 8, in a single row. *Pappus none.* Stem slender. Heads small, in loose panicles.

33. **Cicho'rium.** Flowers bright blue, showy, Scales of the involucre in 2 rows, the outer of 5 short scales, the inner of 8–10 scales. *Pappus chaffy.* Heads sessile, 2 or 3 together.

34. **Leon'todon.** Flowers yellow. Involucre with bractlets at the base. *Pappus of plumose bristles,* these broader at the base. Heads borne on branching scapes. Leaves radical.

35. **Hiera'cium.** Flowers yellow. Scales of the involucre more or less imbricated. *Pappus a single row of tawny hair-like rough bristles.* Heads corymbose.

36. **Nab'alus.** Flowers yellowish- or greenish-white, often tinged with purple; heads nodding. Involucre of 5–14 scales in a single row, with a few bractlets below. *Pappus copious, of brownish or yellowish rough bristles.*

37. **Tarax'acum.** Flowers yellow, *on slender naked hollow scapes.* Achenes prolonged into a slender thread-like beak. Leaves all radical. (See Part I., Chapter viii.)

38. **Lactu'ca.** Flowers pale yellow or purplish. Florets few (about 20) in the head. Scales of the involucre in 2 or more rows of unequal length. *Achenes with long thread-form beaks,* and a pappus of very soft white bristles. Heads numerous, panicled. Tall smooth herbs with runcinate leaves.

39. **Mulge'dium.** Flowers chiefly blue. Structure of the heads and general aspect of the plant as in Lactuca, *but the beak of the achenes short and thick, and the pappus tawny.* Heads in a dense panicle.

40. **Son'chus.** Flowers pale yellow. Heads many-flowered, enlarging at the base. Achenia without beaks. Pappus very soft and white. Tall glaucous herbs with *spiny-toothed leaves.*

41. **Tragopo'gon.** Flowers yellow. Heads large. Involucre of about 12 lanceolate rather fleshy scales in one row, somewhat united at the base. Achenes with long tapering beaks. Pappus of plumose bristles, 5 of these longer and naked at the summit. Leaves entire, straight-veined, clasping.

1. CIR'SIUM, Tourn. COMMON THISTLE.

1. **C. lanceola'tum,** Scop. (*Cnicus lanceolatus,* Hoffm., in Macoun's Catalogue.) (COMMON THISTLE.) *All the scales of the involucre prickly-pointed.* Leaves decurrent, pinnatifid, the lobes prickly-pointed, rough above, woolly with webby hairs beneath. —Fields and roadsides everywhere.

2. **C. dis'color**, Spreng. (*Cnicus altissimus*, Willd., var. **discolor**, Gray, in Macoun's Catalogue.) The *inner* scales of the involucre not prickly. Stem grooved. Leaves prickly, green above, *white-woolly beneath*. Flowers pale purple. Whole plant with a whitish aspect.—Dry thickets.

3. **C. mu'ticum**, Michx. (*Cnicus muticus*, Pursh, in Macoun's Catalogue.) (SWAMP THISTLE.) *Scales of the webby involucre hardly prickly*, and not spreading. *Stem very tall*, and smoothish, and sparingly leafy. *Heads single or few*.—Swamps and low woods.

4. **C. arvense**, Scop. (*Cnicus arvensis*, Pursh, in Macoun's Catalogue.) (CANADA THISTLE.) Scales of the involucre with reflexed points. Leaves prickly, smooth both sides, or slightly woolly beneath. Roots extensively creeping. Heads small and numerous.—Fields and roadsides.

2. ONOPOR'DON, Vaill. SCOTCH THISTLE.

O. acan'thium, L. A coarse branching herb, 2–4 feet high, with woolly stem and leaves. Bristles of the pappus united at the base into a ring.—Roadsides and old fields; not common.

3. LAP'PA, Tourn. BURDOCK.

L. officina'lis, All., var. **major**, Gray. (*Arctium Lappa*, L., in Macoun's Catalogue.) A coarse plant with very large cordate petioled leaves, and numerous small globular heads of purple flowers. The involucre forms a bur which clings to one's clothing, or to the hair of animals.—Near dwellings, mostly in manured soil.

4. CENTAURE'A, L. STAR-THISTLE.

C. Cy'anus, L. (BLUE-BOTTLE.) An old garden plant, found occasionally along roadsides. False rays very large. Scales of the involucre fringed. Leaves linear, entire or nearly so. Stem erect. Heads single at the ends of the branches.

5. XAN'THIUM, Tourn. CLOTBUR.

1. **X. struma'rium**, L., var. **echina'tum**, Gray. (*X. Canadense*, Mill, var. *echinatum*, Gray, in Macoun's Catalogue.) (COMMON COCKLEBUR.) Stem rough, not prickly or spiny.

Leaves broadly triangular, and somewhat heart-shaped, long-petioled. Fruit a hard 2-celled bur, nearly an inch long, clothed with stiff hooked prickles, the two beaks of the fruit long and usually incurved.—Low river banks.

2. **X. spino'sum.** (SPINY CLOTBUR.) Stem armed with conspicuous straw-coloured triple slender spines, at the bases of the lanceolate short-petioled leaves, the latter white-woolly beneath. —Town of Dundas, Ontario; the seeds having been brought in wool from South America.

6. AMBRO'SIA, Tourn. RAGWEED.

1. **A. artemisiæfo'lia,** L. (HOG-WEED.) Stem erect, 1–3 feet high, branching, hairy. *Leaves twice-pinnatifid*, the lobes linear, paler beneath.—Waste places everywhere, but not so common northward.

2. **A. trif'ida,** L. (GREAT RAGWEED) is found in low grounds in the south-west of Ontario; also at Montreal and Ottawa. Stem stouter than No. 1, 2–4 feet high. *Leaves opposite, deeply 3-lobed*, the lobes oval-lanceolate and serrate.

7. TANACE'TUM, L. TANSY.

T. vulga're, L. (COMMON TANSY.) A very strong-scented herb, 2–4 feet high, smooth. Leaves twice-pinnate, the lobes serrate, as are also the wings of the petiole. Heads densely corymbed. Var. **crispum,** DC., is easily distinguished by its crisper and more incised leaves.—Old gardens and roadsides near dwellings.

8. ARTEMIS'IA, L. WORMWOOD.

1. **A. Canadensis,** Michx. Stem smooth or sometimes hoary with silky down, erect, usually brownish. Lower leaves twice-pinnatifid, the lobes linear.—Shores of the Great Lakes.

2. **A. vulga'ris,** L. (COMMON MUGWORT.) Stem tall, and branching above. *Leaves green and smooth above*, white-woolly beneath, pinnatifid, the lobes linear-lanceolate. Heads small, erect, in panicles. Flowers purplish.—Old fields near dwellings.

3. **A. Absin'thium,** L. (COMMON WORMWOOD.) Somewhat shrubby. Whole plant silky-hoary. Stem angular, branched, the branches with drooping extremities. Leaves 2–3-pinnately-

divided, the lobes lanceolate. Heads nodding.—Escaped from gardens in some places.

9. **ERECHTHI'TES**, Raf. FIREWEED.

E. hieracifo'lia, Raf. Stem tall, grooved. Leaves sessile, lanceolate, cut-toothed, upper ones clasping.—Common in places recently over-run by fire.

10. **GNAPHA'LIUM**, L. CUDWEED.

1. **G. decur'rens**, Ives. (EVERLASTING.) Stem erect, 2 feet high, *clammy-pubescent*, white-woolly on the branches. Heads corymbed. Leaves linear-lanceolate, partly clasping, *decurrent*.—Fields and hillsides.

2. **G. polyceph'alum**, Michx. (COMMON EVERLASTING.) Stem erect, 1–2 feet high, white-woolly. Heads corymbed. Leaves lanceolate, tapering at the base, *not decurrent*.—Old pastures and woods.

3. **G. uligino'sum**, L. (LOW CUDWEED.) Stem spreading, 3–6 inches high, white-woolly. Leaves linear. Heads small *in crowded terminal clusters* subtended by leaves.—Low grounds.

11. **ANTENNA'RIA**, Gærtn. EVERLASTING.

1. **A. margarita'cea**, R. Brown. (PEARLY EVERLASTING.) (*Anaphalis margaritacea*, Benth. and Hook., in Macoun's Catalogue.) Stem in clusters, downy. Leaves linear-lanceolate, taper-pointed, sessile. Scales of the involucre pearly-white. Heads in corymbs.—Along fences and in open woods.

2. **A. plantaginifo'lia**, Hook. (PLANTAIN-LEAVED E.) *Stem scape-like, 4–6 inches high.* Radical leaves spathulate or obovate; stem-leaves few, linear. Heads small, in a crowded corymb. Involucre white or purplish.—Old pastures and woods.

12. **LIA'TRIS**, Schreb. BLAZING-STAR.

1. **L. cylindra'cea**, Michx. Stem wand-like, 6–18 inches high. Leaves linear, rigid, generally 1-nerved. Heads few, cylindrical.—Sandy fields and thickets.

2. **L. spica'ta**, Willd. Stem stout and rigid, 2–5 feet high, very leafy. Leaves linear, erect, the lowest 3–5-nerved. Heads crowded in a long spike.—Low grounds, south-western Ontario.

13. EUPATO'RIUM, Tourn. THOROUGHWORT.

1. **E. purpu'reum**, L. (JOE-PYE WEED. TRUMPET-WEED.) Stem tall and simple. *Leaves petioled, 3–6 in a whorl. Flowers purplish or flesh-coloured.* Heads in dense corymbs.—Low grounds.

2. **E. perfolia'tum**, L. (BONESET.) Stem short, hairy. *Leaves rugose, connate-perfoliate, tapering.* Flowers whitish. Corymbs very large.—Low grounds.

3. **E. ageratoi'des**, L. (WHITE SNAKE-ROOT.) Stem very smooth, commonly branching, 2–3 feet high. *Leaves opposite, petioled, broadly ovate, pointed, coarsely serrate.* Flowers white, in corymbs.—Low rich woods.

14. SENE'CIO, L. GROUNDSEL.

1. **S. vulga'ris**, L. (COMMON GROUNDSEL.) *Ray-florets wanting.* Stem low, branching. Leaves pinnatifid and toothed, clasping. Flowers yellow, terminal.—Cultivated and waste grounds.

2. **S. au'reus**, L. (GOLDEN RAGWORT. SQUAW-WEED.) *Rays 8–12.* Stem smooth, or woolly when young, 1–2 feet high. Root-leaves simple, rounded, usually cordate, crenately-toothed, *long-petioled.* Stem-leaves sessile, lanceolate, deeply pinnatifid. Heads in a corymb nearly like an umbel.—Swamps, and often in gardens.

15. IN'ULA, L. ELECAMPANE.

I. **Hele'nium**, L. (COMMON ELECAMPANE.) Stem stout, 2–5 feet high. Root-leaves very large, ovate, petioled. Stem-leaves clasping. Rays numerous, narrow.—Roadsides.

16. SOLIDA'GO, L. GOLDEN-ROD.

* *Heads clustered in the axils of the feather-veined leaves.*

1. **S. squarro'sa**, Muhl. Stem stout, 2–5 feet high, simple, hairy above. *Scales of the involucre with reflexed herbaceous tips.* Leaves large, oblong, serrate, veiny ; the lower tapering into a long-winged petiole, the upper sessile and entire. Heads in racemose clusters, *the whole forming a dense, leafy, interrupted, compound spike.*—Rocky woods.

2. **S. bi'color**, L. Stem hoary-pubescent, usually simple, Leaves oval-lanceolate, acute at both ends ; the lower oval and

tapering into a petiole, serrate. Heads in short racemes in the upper axils, the whole forming an interrupted spike or compound raceme. *Ray-florets whitish.* The variety **con'color** has *yellow* rays.—Dry banks and thickets.

3. **S. latifo'lia,** L. Stem smooth, not angled, zigzag, 1–3 feet high. Leaves broadly ovate or oval, strongly and sharply serrate, pointed at both ends. Heads in very short axillary clusters.—Cool woods.

4. **S. cæ'sia,** L., var. **axilla'ris,** Gray. Stem smooth, angled, glaucous, slender, usually branching above. Leaves smooth, lanceolate, pointed, serrate, sessile. Heads in very short clusters in the axils of the leaves.—Rich woods and hillsides.

* * *Racemes terminal, erect, loosely thyrsoid, not one-sided. Leaves feather-veined.*

5. **S. Virga-aurea,** L., var. **hu'milis,** Gray. (*S. humilis*, Pursh, in Macoun's Catalogue.) Stem low, 3–6 inches high, usually smooth; the heads, peduncles, etc., mostly glutinous. Leaves lanceolate or oblanceolate, serrate or entire, the radical ones petiolate, obtuse, and serrate at the apex.—Rocky banks; not common.

* * * *Heads in a compound corymb terminating the simple stem, not at all racemose.*

6. **S. Ohioen'sis,** Riddell. Very smooth throughout. Stem slender, reddish, leafy. Radical leaves very long (often a foot), slightly serrate towards the apex, tapering into long margined petioles; stem-leaves oblong-lanceolate, entire, sessile.—Wet grassy shores of Red Bay, Lake Huron.

* * * * *Heads in one-sided racemes, spreading or recurved.*

7. **S. argu'ta,** Ait. (*S. juncea*, Ait., in Macoun's Catalogue.) Whole plant smooth, 1–4 feet high, rigid, branching above. Lower leaves oval or elliptical-lanceolate, serrate with spreading teeth, pointed, tapering into winged and ciliate petioles; upper ones lanceolate. Racemes very dense, naked, at length elongated and recurved. The variety **juncea** has narrower and less serrate leaves.—Woods and banks.

8. **S. Muhlenber'gii,** Torr. and Gr. (*S. arguta*, Ait., in Macoun's Catalogue.) Stem smooth, angled or furrowed. Leaves

large and thin, ovate; the upper elliptical-lanceolate. Racemes much shorter and looser than in No. 7, and the rays much larger. —Moist woods and thickets.

9. **S. altis'sima**, L. (*S. rugosa*, Mill, in Macoun's Catalogue.) Stem rough-hairy, *less than a foot high*. Leaves ovate-lanceolate or oblong, coarsely serrate, veiny, *often rugose*. Racemes panicled, spreading.—Borders of fields and copses.

10. **S. neglecta**, Torr. and Gr. Stem smooth, 2–3 feet high, stout. Leaves thickish, smooth both sides, the upper oblong-lanceolate, nearly entire, the lower ovate-lanceolate or oblong, sharply serrate, tapering into a petiole. Heads rather large. Racemes short and dense, at first erect and scarcely one-sided, at length spreading.—Swamps.

11. **S. nemora'lis**, Ait. Stem minutely and closely hoary-pubescent, simple or corymbed. Leaves more or less hoary, slightly 3-nerved, obscurely serrate or entire; the lower oblanceolate, somewhat crenate, and tapering into a petiole. Racemes numerous, dense, at length recurved, forming a large panicle.—Dry fields.

* * * * * *Racemes one-sided and recurved, and the leaves plainly 3-ribbed.*

12. **S. Canadensis**, L. Stem rough-hairy, tall and stout. Leaves lanceolate, serrate, pubescent beneath, rough above. Panicle exceedingly large.—Very common along fences and in moist thickets.

13. **S. sero'tina**, Ait. (*S. serotina*, Ait., var. *gigantea*, Gray, in Macoun's Catalogue.) Stem very smooth, tall and stout. Leaves lanceolate, serrate, the veins beneath pubescent. Panicle pyramidal, of many curved racemes.—Low thickets and meadows.

14. **S. gigante'a**, Ait. (*S. serotina*, Ait., in Macoun's Catalogue.) Stem smooth, stout. Leaves lanceolate, taper-pointed, sharply serrate, except at the base, smooth both sides, *rough-ciliate*. Panicle large, *pubescent*.—Open thickets and meadows.

* * * * * * *Inflorescence a flat-topped corymb.*

15. **S. lanceola'ta**, L. Stem pubescent above, much branched. Leaves linear-lanceolate, the nerves (3–5) and margins rough-pubescent. Heads in dense corymbed clusters, giving a decidedly characteristic aspect to this species.—Low river-margins.

17. NARDOS'MIA, Cass. Sweet Coltsfoot.

N. palma'ta, Hook. Leaves rounded, somewhat kidney-shaped, palmately 5–7-lobed, the lobes toothed and cut.—Cedar swamps and bogs.

18. ASTER, L. Starwort. Aster.

* *Leaves, at least the lower ones, heart-shaped and petioled.*

1. **A. corymbo'sus,** Ait. Rays white or nearly so. Heads in corymbs. Stem slender, 1–2 feet high, zigzag. Leaves thin, smoothish, sharp-pointed, coarsely serrate, all the lower ones on slender naked petioles.—Woodlands.

2. **A. macrophyl'lus,** L. Rays white or bluish. Stem stout, 2–3 feet high. Leaves thickish, rough, finely serrate, the lower long-petioled. Heads in closer corymbs than in No. 1.—Woodlands.

3. **A. azu'reus,** Lindl. Rays bright blue. Heads racemed or panicled. Stem roughish, erect, racemose-compound above. Leaves entire or nearly so, rough; the lower ovate-lanceolate, on long petioles; the upper lanceolate or linear, sessile. The latest flowering of our Asters.—Dry soil.

4. **A. undula'tus,** L. Rays bright blue. Heads racemed or panicled. Stem hoary with close pubescence, spreading. Leaves with somewhat wavy margins, ovate or ovate-lanceolate, roughish above, downy beneath; the lowest cordate, on margined petioles; the upper with *winged short petioles* clasping at the base, or sessile.—Dry woods.

5. **A. cordifo'lius,** L. Rays pale blue or nearly white. Heads *small*, profuse, panicled. Stem much branched. Leaves thin, sharply serrate, the lower on slender ciliate petioles.—Woods and along fences.

6. **A. sagittifo'lius,** Willd. Rays pale blue or purple. Heads *small*, in dense compound racemes or panicles. Stem smooth or nearly so, erect, with ascending branches. Leaves ovate-lanceolate, pointed, pubescent, the lowest on long margined petioles, the upper contracted into a winged petiole, or lanceolate or linear.—Thickets and along fences.

* * *Upper leaves all sessile or clasping by a heart-shaped base; lower ones not heart-shaped.*

7. **A. lævis**, L. *Rays large*, purple or blue. Very smooth throughout. Heads in a close panicle. Leaves lanceolate or ovate-lanceolate, chiefly entire, rough on the margins, *the upper ones clasping by an auricled base.*—Dry woods.

8. **A. Novæ-An'gliæ**, L. Rays many, narrow, violet-purple; *heads large. Involucre of many slender equal scales, apparently in a single row, clammy.* Stem stout, 3–8 feet high, hairy, corymbed above. Leaves very numerous, lanceolate, entire, clasping by an auricled base, pubescent.—River-banks and borders of woods.

9. **A. puni'ceus**, L. *Rays long*, lilac-blue. *Scales of the involucre narrowly linear, loose.* Stem 3–6 feet high, stout, rough-hairy, *usually purple below.* Leaves oblong-lanceolate, clasping by an auricled base, sparingly serrate in the middle, rough above, smooth beneath, pointed.—Swamps; usually clustered.

10. **A. longifo'lius**, Lam. Rays large, numerous, purplish-blue. *Scales of the involucre in several rows, linear, with awl-shaped spreading green tips. Stem smooth.* Leaves lanceolate or linear, taper-pointed, *shining above.* Heads solitary or few on the branchlets.—Moist thickets along streams.

* * * *None of the leaves heart-shaped; those of the stem sessile, tapering at the base (except in No. 11).*

11. **A. multiflo'rus**, Ait. Rays white. Stem pale or hoary with minute pubescence, 1 foot high, bushy. *Leaves crowded, linear*, with rough margins; the upper partly clasping. Heads crowded on the racemose branches. Scales of the involucre with spreading green tips.—Dry soil.

12. **A. Tradescan'ti**, L. Rays white or whitish. Scales of the involucre narrowly linear, in 3 or 4 rows. Heads small, very numerous, in 1-sided *close* racemes on the branches. Stem 2–4 feet high, bushy, *smooth.* Leaves linear-lanceolate, the larger ones with a *few remote teeth* in the middle.—Moist banks.

13. **A. miser**, L. (*A. diffusus*, Hook., in Macoun's Catalogue.) Rays pale blue or whitish. Involucre nearly as in No. 12. Stem *more or less hairy*, much branched. Heads small, in *loose* racemes

on the spreading branches. Leaves lanceolate, acute at each end, *sharply serrate in the middle.*—Low grounds.

14. **A. simplex,** Willd. Rays pale blue or whitish. Scales of the involucre linear-awl-shaped. Stem stout, smooth or nearly so, with numerous leafy branches. Heads medium-sized, somewhat corymbose. Leaves smooth, lanceolate, tapering at both ends, the lower serrate.—Moist and shady banks.

15. **A. tenuifo'lius,** L. Rays pale blue or whitish. Scales of the involucre linear-awl-shaped, with very slender points. Heads medium-sized, in panicled racemes. *Leaves long, narrowly lanceolate, tapering to a long slender point,* the lower usually serrate in the middle. Stem much branched, pubescent in lines. —Low thickets.

16. **A. nemora'lis,** Ait., is found in the eastern provinces and in Muskoka. Rays lilac-purple. Stem slender and leafy, the upper branches terminating in 1-flowered nearly naked peduncles. Leaves rigid, narrowly lanceolate, nearly entire, *with revolute margins.*

17. **A. ptarmicoi'des,** Torr. and Gr. Rays pure white. Stems clustered, generally a foot high, each bearing a flat corymb of small heads. Leaves linear-lanceolate, acute, rigid, entire, mostly 1-nerved, with rough margins.—Dry or gravelly hills. Our earliest Aster.

18. **A. acumina'tus,** Michx. Rays white or faintly purple. Stem about a foot high, somewhat hairy, zigzag, panicled-corymbose at the top. Leaves large, thin, oblong-lanceolate, pointed, coarsely toothed towards the apex, entire at the base.—Cool sandy woods; mostly in eastern Ontario.

19. ERIG'ERON, L. FLEABANE.

1. **E. Canadense,** L. (HORSE-WEED. BUTTER-WEED.) Rays white, *but very inconspicuous,* shorter than their tubes. Heads very small, numerous, in panicled racemes. Stem 3–5 feet high, erect and wand-like, bristly-hairy. Leaves linear, mostly entire. Common in burnt woods and new clearings.

2. **E. bellidifo'lium,** Muhl. (ROBIN'S PLANTAIN.) Rays *bluish-purple,* numerous. Heads medium-sized, few, on slender corym-

bose peduncles. Stem hairy, *producing offsets from the base.* Radical leaves spathulate or obovate, toothed above the middle; stem-leaves oblong, *few,* sessile or partly clasping, entire.—Thickets.

3. **E. Philadel'phicum,** L. (COMMON FLEABANE.) Rays *rose-purple, very numerous and narrow.* Heads small, few, in corymbs. Stem hairy, with *numerous* stem-leaves. Radical leaves spathulate and toothed; the upper ones clasping by a heart-shaped base, entire.—Moist grounds.

4. **E. strigo'sum,** Muhl. (DAISY FLEABANE.) Rays white, conspicuous, numerous. *Pappus plainly double.* Stem and leaves roughish with minute appressed hairs, or nearly smooth. Lower leaves spathulate and slender-petioled, *entire or nearly so,* the upper lanceolate, scattered.—Dry fields and meadows.

5. **E. an'nuum,** Pers. (LARGER DAISY FLEABANE.) Rays white, tinged with purple. Pappus double. Stem rough with spreading hairs. Leaves *coarsely toothed;* the lower ovate, tapering into a margined petiole; the upper ovate-lanceolate. Heads corymbed.—Fields and meadows.

20. **DIPLOPAP'PUS,** Cass. DOUBLE-BRISTLED ASTER.

D. umbella'tus, Torr. and Gr. Stem smooth, leafy to the top, tall, simple. Leaves lanceolate, long-pointed. Heads very numerous in flat compound corymbs.—Moist thickets.

21. **HELE'NIUM,** L. SNEEZE-WEED.

H. autumna'le, L. (SNEEZE-WEED.) Stem nearly smooth. Leaves lanceolate, toothed. Disk globular.—Low river- and lake-margins.

22. **LEUCAN'THEMUM,** Tourn. OX-EYE DAISY.

L. vulga're, Lam. (*Chrysanthemum Leucanthemum,* L., in Macoun's Catalogue.) (OX-EYE DAISY. WHITE-WEED.) Stem erect, naked above, bearing a single large head. Leaves pinnatifid or cut-toothed, the lowest spathulate, the others partly clasping.—Pastures and old fields.

23. **MARU'TA,** Cass. MAY-WEED.

M. Cot'ula, DC. (COMMON MAY-WEED.) Stem branching. Leaves thrice-pinnate, finely dissected.—Roadsides everywhere.

24. RUDBECK'IA, L. Cone-flower.

1. **R. lacinia'ta,** L. Rays linear, 1–2 inches long, drooping. *Disk greenish-yellow.* Stem tall, *smooth,* branching. Lowest leaves pinnate, of 5–7 lobed leaflets; upper ones 3–5-parted, or the uppermost undivided and generally ovate. Heads terminal, long-peduncled.—Swamps.

2. **R. hir'ta,** L. Rays bright yellow. *Disk purplish-brown.* Stem very *rough-hairy,* naked above, bearing single large heads. Leaves 3-ribbed, the lowest spathulate, narrowed into a petiole, the upper ones sessile.—Meadows.

25. HELIAN'THUS, L. Sun-flower.

1. **H. strumo'sus,** L. Stem 3–4 feet high, smooth below. Leaves broadly lanceolate, rough above and whitish beneath, pointed, serrate with small appressed teeth, short-petioled. Rays about 10.—Moist copses and low grounds.

2. **H. divarica'tus,** L. Stem 1–4 feet high, *smooth,* simple or forking above. Leaves all opposite, widely spreading, *sessile, rounded or truncate at the base,* ovate-lanceolate, *3-nerved,* long-pointed, serrate, *rough on both sides.* Heads few, on short peduncles. Rays about 12.—Open thickets and dry plains.

3. **H. decapet'alus,** L. Stem 3–6 feet high, branching, smooth below, rough above. Leaves *thin, green on both sides, ovate, coarsely serrate,* pointed, abruptly contracted into short margined petioles. Rays usually 10.—Thickets and river-banks.

4. **H. gigante'us,** L. Stem tall, *hairy or rough,* branching above. Leaves lanceolate, pointed, serrate, very rough above, hairy below, narrowed and ciliate at the base. Heads somewhat corymbed, not large. Disk yellow; rays pale yellow, 15–20.—Low grounds, western and south-western Ontario.

5. **H. tubero'sus,** L., (Jerusalem Artichoke) has escaped from cultivation in some places. It is at once recognized by its tubers.

26. BIDENS, L. Bur-Marigold.

1. **B. frondo'sa,** L. (Common Beggar-ticks.) *Rays none. Achenes flat,* wedge-obovate, *ciliate on the margins with bristles pointing upwards,* 2-awned. Stem tall, branched. Leaves thin,

long-petioled, pinnately 3–5-divided, the leaflets ovate-lanceolate, pointed, serrate.

2. **B. conna'ta,** Muhl. (SWAMP BEGGAR-TICKS.) *Rays none.* Achenes flat, narrowly wedge-shaped, 2–4-awned, *ciliate with minute bristles pointing downwards.* Stem 1–2 feet high, smooth. Leaves lanceolate, pointed, serrate, tapering and connate at the base, the lowest often 3-parted and decurrent on the petiole. —In shallow water and low grounds.

3. **B. cer'nua,** L. (SMALLER BUR-MARIGOLD.) *Rays short, pale yellow.* Achenes flat, wedge-obovate, *4-awned, ciliate with bristles pointing downwards.* Stem nearly smooth, 5–10 inches high. Leaves all simple, lanceolate, unequally serrate, hardly connate. Heads nodding.—Wet places.

4. **B. chrysanthemoi'des,** Michx. (LARGER BUR-MARIGOLD.) *Rays an inch long, showy, golden yellow.* Achenes wedge-shaped, 2–4-awned, *bristly downwards.* Stem smooth, 6–30 inches high, erect or ascending. Leaves lanceolate, tapering at both ends, connate, regularly serrate.—Swamps and ditches.

5. **B. Beck'ii,** Torr. (WATER MARIGOLD.) *Aquatic.* Stems long and slender. Immersed leaves dissected into fine hair-like divisions; those out of water lanceolate, slightly connate, toothed. Rays showy, golden yellow, larger than the involucre. *Achenes linear, bearing 4–6 very long awns barbed towards the apex.*—Ponds and slow streams.

27. HELIOP'SIS, Pers. OX-EYE.

H. lævis, Pers. Stem smooth, slender, branching. Leaves ovate-lanceolate, acute, sharply serrate, on slender petioles. Heads showy; peduncles elongated.—Dry open thickets; London and westward.

28. ACHILLE'A, L. YARROW.

A. millefo'lium, L. (MILFOIL.) Stems simple. Leaves dissected into fine divisions. Corymb flat-topped. Rays only 4 or 5, short.—Fields and along fences; very common.

29. POLYM'NIA, L. LEAF-CUP.

P. Canadensis, L. A coarse clammy-hairy herb. Lower leaves opposite, petioled, pinnatifid; the upper alternate, angled or lobed. Heads small; rays pale yellow.—Shaded ravines, south-westward.

30. SIL'PHIUM, L. Rosin-Plant.

1. **S. perfolia'tum,** L., (Cup-Plant) is found in south-western Ontario. Stem stout, *square*, 4–8 feet high. Leaves ovate, coarsely toothed, the upper ones united by their bases.

2. **S. terebinthina'ceum,** L. (Prairie Dock.) Stem tall, *round*, naked above, smooth. Radical leaves sometimes 2 feet long, rough-hairy, coarsely serrate, on slender petioles. Heads small, loosely panicled.—Open woods and grassy banks, south-western Ontario.

31. CYNTHIA, Don. Cynthia.

C. Virgin'ica, Don. (*Krigia amplexicaulis*, Nutt., in Macoun's Catalogue.) Roots fibrous. Stem-leaves 1–2, oblong or lanceolate-spathulate, clasping, mostly entire, the radical ones on short winged petioles. Peduncles 2–5.—South-western Ontario.

32. LAMP'SANA, Tourn. Nipple-wort.

L. commu'nis, L. Very slender and branching. Leaves angled or toothed. Heads small, loosely panicled.—Borders of springs; not common.

33. CICHO'RIUM, Tourn. Succory. Cichory.

C. In'tybus, L. Stem-leaves oblong or lanceolate, partly clasping; radical ones runcinate.—Roadsides and waste places.

34. LEON'TODON, L. Fall Dandelion.

L. autumna'le, L. (Fall Dandelion.) Leaves lanceolate, laciniate-toothed or pinnatifid. *Scape branched.*—Roadsides and waste places; not common.

35. HIERA'CIUM, Tourn. Hawkweed.

1. **H. Canadensis,** Michx. (Canada Hawkweed.) *Heads large.* Stem simple, leafy, corymbed, 1–3 feet high. *Peduncles downy.* Leaves ovate-oblong, with a few coarse teeth, somewhat hairy, sessile, or the uppermost slightly clasping. Achenes tapering towards the base.—Dry banks and plains.

2. **H. scabrum,** Michx. (Rough H.) *Heads small.* Stem stout, 1–3 feet high, *rough-hairy,* corymbose. *Peduncles or involucre densely clothed with dark bristles.* Achenes not tapering.—Sandy woods and thickets.

3. **H. Gronovii,** L. (Hairy H.) Heads small. Stem wand-like, leafy and very hairy below, *naked above,* forming a long and narrow panicle. *Achenes with a very taper summit.*—Dry soil, western Ontario.

4. **H. veno'sum,** L., (Rattlesnake-weed) with a smooth naked scape (or bearing one leaf), and a loose corymb of very slender peduncles, is found in the Niagara region and south-westward.

36. **NAB'ALUS,** Cass. Rattlesnake-root.

1. **N. albus,** Hook. (*Prenanthes alba,* L., in Macoun's Catalogue. (White Lettuce.) Heads 8–12-flowered. *Pappus deep cinnamon-coloured.* Stem 2–4 feet high, smooth and glaucous. corymbose-paniculate. Leaves triangular-halberd-shaped, or 3–5-lobed, the uppermost oblong and undivided.—Rich woods.

2. **N. altis'simus,** Hook. (*Prenanthes altissima,* L., in Macoun's Catalogue.) (Tall White Lettuce.) Heads 5–6-flowered. *Pappus pale straw-coloured.* Stem taller but more slender than in No. 1, *with a long leafy panicle at the summit.*—Rich woods.

3. **N. racemo'sus,** Hook. (*Prenanthes racemosa,* Michx., in Macoun's Catalogue.) Heads about 12-flowered. Involucre and peduncles *hairy.* Stem wand-like, smooth. Leaves oval or oblong-lanceolate, slightly toothed. Heads crowded in a long and narrow interruptedly spiked panicle. Pappus straw-colour; flowers flesh-colour.—Shore of Lake Huron and south-westward.

37. **TARAX'ACUM,** Haller. Dandelion.

T. Dens-leo'nis, Desf. (Common Dandelion.) Outer involucre reflexed. Leaves runcinate.—Fields everywhere.

38. **LACTU'CA,** Tourn. Lettuce.

1. **L. Canadensis,** L. (Wild Lettuce.) Heads numerous, in a long and narrow naked panicle. Stem stout, smooth, hollow, 4–9 feet high. Leaves mostly runcinate, partly clasping, pale beneath; the upper entire. Achenes longer than their beaks.—Borders of fields and thickets.

2. **L. integrifo'lia,** L. Stem 3–6 feet high; leaves all undivided, entire or slightly toothed. Flowers pale yellow, cream-colour, or purple.—Dry soil.

3. **L. hirsu'ta,** Muhl. Leaves runcinate, the midrib beneath often sparingly bristly-hairy. Flowers yellowish-purple, rarely white.—Dry soil.

39. MULGE'DIUM, Cass. FALSE OR BLUE LETTUCE.

M. leucophæ'um, DC. (*Lactuca leucophæa*, Gray, in Macoun's Catalogue.) Stem tall and very leafy. Heads in a dense compound panicle.—Borders of damp woods and along fences.

40. SON'CHUS, L. SOW-THISTLE.

1. **S. olera'ceus,** L. (COMMON SOW-THISTLE.) Stem-leaves runcinate, slightly toothed with soft spiny teeth, clasping; *the auricles acute.*—Manured soil about dwellings.

2. **S. asper,** Vill. (SPINY-LEAVED S.) Leaves *hardly lobed*, fringed with soft spines, clasping; *the auricles rounded.* Achenes *margined.*—Same localities as No. 1.

3. **S. arven'sis,** L., (FIELD S.) with bright yellow flowers and bristly involucres and peduncles, is found eastward.

41. TRAGOPO'GON, L. GOAT'S BEARD. SALSIFY.

T. praten'sis, L. (YELLOW GOAT'S BEARD.) Spreading westward along the railway lines.

ORDER L. LOBELIA'CEÆ. (LOBELIA FAMILY.)

Herbs, with milky acrid juice, alternate leaves, and loosely racemed flowers. Corolla irregular, 5-lobed, *the tube split down one side.* Stamens 5, syngenesious, and commonly also monadelphous, *free from the corolla.* Calyx-tube adherent to the many-seeded ovary. Style 1. The only genus is

LOBE'LIA, L. LOBELIA.

1. **L. cardina'lis,** L. (CARDINAL-FLOWER.) Corolla *large, deep red.* Stem simple, 2–3 feet high, smooth. Leaves oblong-lanceolate, slightly toothed. Bracts of the flowers leaf-like.—Low grounds.

2. **L. syphilit'ica,** L. (Great Lobelia.) Corolla *rather large, light blue.* Stem hairy, simple, 1–2 feet high. Leaves thin, acute at both ends, serrate. Calyx-lobes half as long as the corolla, the tube hemispherical. Flowers in a dense spike or raceme.—Low grounds.

3. **L. infla'ta,** L. (Indian Tobacco.) Flowers *small, $\frac{1}{6}$ of an inch long, pale blue.* Stem leafy, *branching,* 8–18 inches high, pubescent. Leaves ovate or oblong, toothed. *Pods inflated. Racemes leafy.*—Dry fields.

4. **L. spica'ta,** Lam. Flowers small, $\frac{1}{3}$ *of an inch long, pale blue.* Stem slender, erect, *simple,* 1–3 feet high, minutely pubescent below. Leaves barely toothed, the lower spathulate or obovate, the upper reduced to linear bracts.—*Racemes long and naked.*—Sandy soil.

5. **L. Kal'mii,** L. Flowers small, $\frac{1}{3}$ of an inch long, *light blue. Stem low,* 4–18 inches high, *very slender.* Pedicels filiform, as long as the flowers, with 2 minute bractlets above the middle. Leaves mostly linear, the radical ones spathulate and the uppermost reduced to bristly bracts.—Wet rocks and banks, chiefly northward.

6. **L. Dortman'na,** L., (Water Lobelia) with small leaves all tufted at the root, and a scape 5 or 6 inches long with a few small light-blue pedicelled flowers at the summit, occurs in the shallow borders of ponds in Muskoka.

Order LI. CAMPANULA'CEÆ. (Campanula F.)

Herbs with milky juice, *differing from the preceding Order chiefly in having a regular 5-lobed corolla (bell-shaped or wheel-shaped), separate stamens (5), and 2 or more (with us, 3) stigmas.*

Synopsis of the Genera.

1. **Campan'ula.** Calyx 5-cleft. Corolla generally bell-shaped, 5-lobed. Pod short.
2. **Specula'ria.** Calyx 5-cleft. Corolla nearly wheel-shaped, 5-lobed. Pod prismatic or oblong.

1. CAMPAN'ULA, Tourn. Bell-flower.

1. **C. rotundifo'lia,** L. (Harebell.) Flowers blue, loosely panicled, on long slender peduncles, nodding. Stem slender,

branching, several-flowered. Root-leaves round-heart-shaped; stem-leaves linear. Calyx-lobes awl-shaped.—Shaded cliffs.

2. **C. aparinoi'des,** Pursh. (MARSH BELL-FLOWER.) Flowers *white* or nearly so, about $\frac{1}{3}$ of an inch long. *Stem very slender and weak,* few-flowered, *angled, roughened backwards.* Leaves linear-lanceolate. Calyx-lobes triangular.—Wet places in high grass. The plant has the habit of a Galium.

3. **C. America'na,** L. (TALL BELL-FLOWER.) Flowers light blue, about an inch across, *crowded in a leafy spike.* Corolla deeply 5-lobed. *Style long and curved.* Stem 3–6 feet high, simple. Leaves ovate or ovate-lanceolate, taper-pointed, serrate. —Moist rich soil.

2. SPECULA'RIA, Heister. VENUS'S LOOKING-GLASS.

S. perfolia'ta, A. DC. Flowers purplish-blue, only the latter or upper ones expanding. Stem hairy, 3–20 inches high. Leaves roundish or ovate, clasping. Flowers solitary or 2 or 3 together in the axils.—Sterile open ground, chiefly south-westward.

ORDER LII. ERICA'CEÆ. (HEATH FAMILY.)

Chiefly shrubs, *distinguished by the anthers opening, as a rule, by a pore at the top of each cell.* Stamens (as in the two preceding Orders) free from the corolla, as many or twice as many as its lobes. Leaves simple and usually alternate. Corolla in some cases polypetalous.

Synopsis of the Genera.

SUBORDER I. VACCINIEÆ. (WHORTLEBERRY FAMILY.)

Calyx-tube adherent to the ovary. Fruit a berry crowned with the calyx-teeth.

1. **Gaylussa'cia.** Stamens 10, the anthers opening by a pore at the apex. Corolla tubular, ovoid, the border 5-cleft. *Berry 10-celled, 10-seeded.* Flowers white with a red tinge. *Leaves covered with resinous dots.* Branching shrubs.

2. **Vaccin'ium.** Stamens 8 or 10, the anthers prolonged upwards into tubes with a pore at each apex. Corolla deeply 4-parted and revolute, or cylindrical with the limb 5-toothed. Berry 4-celled, or more or less completely 10-celled. Flowers white or reddish, solitary or in short racemes. Shrubs.

3. **Chiog'enes.** Stamens 8, *each anther 2-pointed at the apex.* Corolla bell-shaped, *deeply 4-cleft.* Limb of the calyx 4-parted. Flowers very small, nodding from the axils, with 2 bractlets under the calyx. *Berry white,* 4-celled. A trailing slender evergreen.

SUBORDER II. ERICINEÆ. (HEATH FAMILY PROPER.)

Calyx free from the ovary. Shrubs or small trees. Corolla gamopetalous, except in No. 10.

4. **Arctostaph'ylos.** Corolla urn-shaped, the limb 5-toothed, revolute. Stamens 10, the anthers each with 2 reflexed awns on the back. Fruit a berry-like drupe, 5–10-seeded. A trailing thick-leaved evergreen with nearly white flowers.

5. **Epigæ'a.** Corolla salver-shaped, hairy inside, rose-coloured. Stamens 10; filaments slender; anthers awnless, *opening lengthwise.* Calyx of 5 pointed and scale-like nearly distinct sepals. A trailing evergreen, bristly with rusty hairs.

6. **Gaulthe'ria.** Corolla ovoid, or slightly urn-shaped, 5-toothed, nearly white. Stamens 10, the anthers 2-awned. Calyx 5-cleft, enclosing the pod and *becoming fleshy and berry-like in fruit.* Stems low and slender, leafy at the summit.

7. **Cassan'dra.** Corolla cylindrical, 5-toothed. Stamens 10, the anther-cells tapering into beaks with a pore at the apex, awnless. Calyx of 5 overlapping sepals, and 2 similar bractlets. Pod with a double pericarp, the outer of 5 valves, the inner cartilaginous and of 10 valves. A low shrub with rather scurfy leaves, and white flowers.

8. **Androm'eda.** Corolla globular-urn-shaped, 5-toothed. Calyx of 5 nearly distinct valvate sepals, without bractlets. Stamens 10; the filaments bearded; the anther-cells each with a slender awn. A low shrub, with white flowers in a terminal umbel.

9. **Kal'mia.** Corolla broadly bell-shaped, *with 10 pouches receiving as many anthers.* Shrubs with showy rose-purple flowers.

10. **Le'dum.** Calyx 5-toothed, very small. Corolla of 5 obovate and spreading *distinct petals.* Stamens 5–10. Leaves evergreen, *with revolute margins, covered beneath with rusty wool.*

SUBORDER III. PYROLEÆ. (PYROLA FAMILY.)

Calyx free from the ovary. Corolla polypetalous. More or less herbaceous evergreens.

11. **Py'rola.** Calyx 5-parted. Petals 5, concave. Stamens 10. Stigma 5-lobed. Leaves evergreen, *clustered at the base of an upright scaly-bracted scape which bears a simple raceme of nodding flowers.*

12. **Mone'ses.** Petals 5, orbicular, spreading. Stamens 10. Stigma large, peltate, with 5 narrow radiating lobes. Plant having the aspect of a Pyrola, *but the scape bearing a single terminal flower.*

13. **Chimaph'ila.** Petals 5, concave, orbicular, spreading. Stamens 10. Stigma broad and round, the border 5-crenate. Low plants with running underground shoots, and thick, shining, sharply serrate, somewhat whorled leaves. Flowers corymbed or umbelled on a terminal peduncle.

Suborder IV. MONOTROPEÆ. (Indian-Pipe Family.)

14. **Monot'ropa.** A smooth *perfectly white* plant, parasitic on roots, bearing scales instead of leaves, and a single flower at the summit of the stem.

15. **Pteros'pora.** A purplish-brown clammy-pubescent plant, *parasitic* on the roots of pines. Stem simple. Flowers numerous, nodding, white, forming a raceme.

16. **Hypop'itys.** A tawny or reddish *parasitic* plant, with several flowers in a scaly raceme, the terminal one generally with 5 petals and 10 stamens, and the others with 4 petals and 8 stamens.

1. GAYLUSSA'CIA, H.B.K. Huckleberry.

G. resino'sa, Torr. and Gr. (Black Huckleberry.) Fruit *black, without a bloom.* Racemes short, 1-sided, in clusters. Leaves oval or oblong. Branching shrub, 1–3 feet high.—Low grounds.

2. VACCIN'IUM, L. Cranberry. Blueberry.

1. **V. Oxycoc'cus**, L. (*Oxycoccus vulgaris*, Pursh, in Macoun's Catalogue.) (Small Cranberry.) A creeping or trailing very slender shrubby plant, with ovate acute evergreen leaves only $\frac{1}{4}$ of an inch long, the margins revolute. Corolla rose-coloured, 4-parted, the lobes reflexed. Anthers 8. *Stem 4–9 inches long. Berry only about $\frac{1}{4}$ of an inch across*, often speckled with white. —Bogs.

2. **V. macrocar'pon**, Ait. (*Oxycoccus macrocarpus*, Pursh, in Macoun's Catalogue.) (Large or American Cranberry.) Different from No. 1 in having prolonged stems (1–3 feet long) and the flowering branches lateral. The leaves also are nearly twice as large, and the *berry is fully $\frac{1}{2}$ an inch broad.*—Bogs.

3. **V. Vitis-Idæa**, L. A low plant with erect branches from tufted creeping stems. Leaves evergreen, *obovate*, with revolute margins, shining above, dotted with blackish bristly points beneath. Corolla *bell-shaped*, 4-lobed. Anthers 8–10. Flowers in a short bracted raceme.—Northward and eastward.

4. **V. Pennsylva'nicum**, Lam. (Dwarf Blueberry.) Stem 6–15 inches high, the branches green, angled, and warty. Corolla

cylindrical bell-shaped, 5-toothed. Anthers 10. Flowers in short racemes. Leaves lanceolate or oblong, serrulate with bristly-pointed teeth, smooth and shining on both sides. Berry blue or black, with a bloom.—Dry plains and woods.

5. **V. Canadense,** Kalm. (CANADIAN BLUEBERRY.) Stem 1–2 feet high. Leaves oblong-lanceolate or elliptical, *entire, downy both sides,* as are also the branchlets.—A very common Canadian species.

6. **V. corymbo'sum,** L., (SWAMP-BLUEBERRY) is a tall shrub (3–10 feet) growing in swamps and low grounds, with leaves varying from ovate to elliptical-lanceolate, and flowers and berries very much the same as those in No. 4, but the berries ripen later.

3. **CHIOG'ENES,** Salisb. CREEPING SNOWBERRY.

C. hispid'ula, Torr. and Gr. Leaves very small, ovate and pointed, on short petioles, the margins revolute. The lower surface of the leaves and the branches clothed with rusty bristles. Berries bright white.—Bogs and cool woods.

4. **ARCTOSTAPH'YLOS,** Adans. BEARBERRY.

A. Uva-ursi, Spreng. Flowers in terminal racemes. Leaves alternate, obovate or spathulate, entire, smooth. Berry red.—Bare hillsides.

5. **EPIGÆ'A,** L. GROUND LAUREL. TRAILING ARBUTUS.

E. re'pens, L. (MAYFLOWER.) Flowers in small axillary clusters from scaly bracts. Leaves evergreen, rounded and heart-shaped, alternate, on slender petioles. Flowers very fragrant.—Dry woods in early spring.

6. **GAULTHE'RIA,** Kalm. AROMATIC WINTERGREEN.

G. procum'bens, L. (TEABERRY. WINTERGREEN.) Flowers mostly single in the axils, nodding. Leaves obovate or oval, obscurely serrate, evergreen. Berry bright red, edible.—Cool woods, chiefly in the shade of evergreens.

7. **CASSAN'DRA,** Don. LEATHER-LEAF.

C. calycula'ta, Don. Flowers in 1-sided leafy racemes. Leaves oblong, obtuse, flat.—Bogs.

8. **ANDROM'EDA**, L. ANDROMEDA.

A. polifo'lia, L. Stem smooth and glaucous, 6–18 inches high. Leaves oblong-linear, with strongly revolute margins, white beneath.—Bogs.

9. **KAL'MIA**, L. AMERICAN LAUREL.

K. glau'ca, Ait. (PALE LAUREL.) A straggling shrub about a foot high, with few-flowered terminal corymbs. Branchlets 2-edged. Leaves opposite, oblong, the margins revolute. Flowers ½ an inch across.—Bogs.

10. **LE'DUM**, L. LABRADOR TEA.

L. latifo'lium, Ait. Flowers white, in terminal umbel-like clusters. Leaves elliptical or oblong. Stamens 5, or occasionally 6 or 7.—Bogs.

11. **PY'ROLA**, Tourn. WINTERGREEN. SHIN-LEAF.

1. **P. rotundifo'lia**, L. *Leaves orbicular, thick, shining, usually shorter than the petiole.* Calyx-lobes lanceolate. Flowers white, or in var. **incarna'ta** rose-purple.—Moist woods.

2. **P. ellip'tica**, Nutt. (SHIN-LEAF.) *Leaves elliptical, thin, dull, usually longer than the margined petiole.* Flowers greenish-white.—Rich woods.

3. **P. secunda**, L. Easily recognized by the *flowers of the dense raceme being all turned to one side.* Leaves *ovate.* Style long, protruding.—Rich woods. Var. **pumila** has *orbicular* leaves, and is 3–8-flowered.—Peat-bogs and swamps.

4. **P. chloran'tha**, Swartz, has small roundish dull leaves, converging greenish-white petals, and *the anther-cells contracted below the pore into a distinct neck or horn.*—Open woods.

12. **MONE'SES**, Salisb. ONE-FLOWERED PYROLA.

M. uniflo'ra, Gr. Leaves thin, rounded, veiny, and serrate. Scape 2–4 inches high, bearing a single white or rose-coloured flower.—Deep woods.

13. **CHIMAPH'ILA**, Pursh. PIPSISSEWA.

1. **C. umbella'ta**, Nutt. (PRINCE'S PINE.) Leaves wedge-lanceolate, *acute at the base.* Peduncles 4–7-flowered. Corolla rose- or flesh-coloured.—Dry woods.

2. **C. macula'ta,** Pursh. (SPOTTED WINTERGREEN.) Leaves ovate-lanceolate, *obtuse at the base*, the upper surface *variegated with white*.—Dry woods.

14. **MONOT'ROPA,** L. INDIAN PIPE. PINE-SAP.

M. uniflo'ra, L. (INDIAN PIPE. CORPSE-PLANT.) Smooth, waxy-white, turning black in drying.—Dark rich woods.

15. **PTEROS'PORA,** Nutt. PINE-DROPS.

P. Andromede'a, Nutt. Calyx 5-parted. Corolla ovate, urn-shaped, 5-toothed, persistent. Stamens 10. Stigma 5-lobed. Pod 5-lobed, 5-celled.—Usually under pines in dry woods.

16. **HYPOP'ITYS,** Scop. PINE-SAP.

H. lanugino'sa, Nutt. Somewhat pubescent. Sepals bract-like. Stigma ciliate. Style longer than the ovary, hollow. Pod globular or oval.—Oak and pine woods.

ORDER LIII. AQUIFOLIA'CEÆ. (HOLLY FAMILY.)

Shrubs or small trees, with small axillary polygamous or diœcious flowers, the parts mostly in fours or sixes. Calyx very minute, free from the ovary. Stamens alternate with the petals, attached to their base, the corolla being almost polypetalous. Anthers opening lengthwise. Stigma nearly sessile. Fruit a berry-like 4–8-seeded drupe

1. **ILEX,** L. HOLLY.

I. verticilla'ta, Gr. (BLACK ALDER. WINTERBERRY.) A shrub with the greenish flowers in sessile clusters, or the fertile ones solitary. Parts of the flowers mostly in sixes. Fruit bright red. Leaves alternate, obovate, oval, or wedge-lanceolate, pointed, veiny, serrate.—Swamps and low grounds.

2. **NEMOPAN'THES,** Raf. MOUNTAIN HOLLY.

N. Canadensis, DC. A branching shrub, with grey bark, and alternate oblong nearly entire smooth leaves on slender petioles. Flowers on long slender axillary peduncles, mostly solitary. Petals 4–5, oblong-linear, *distinct*. Fruit light red.—Moist woods.

ORDER LIV. PLANTAGINA'CEÆ. (PLANTAIN FAMILY.)

Herbs, with the leaves all radical, and the flowers in a close spike at the summit of a naked scape. Calyx of 4 sepals, persistent. Corolla 4-lobed, thin and membranaceous, spreading. Stamens 4, usually with long filaments, inserted on the corolla. Pod 2-celled, the top coming off like a lid. Leaves ribbed. The principal genus is

PLANTA'GO, L. PLANTAIN. RIB-GRASS.

1. **P. major,** L. (COMMON P.) *Spike long and slender. Leaves 5–7-ribbed*, ovate or slightly heart-shaped, *with channelled petioles. Pod 7–16-seeded.*—Moist ground about dwellings.

2. **P. Kamtscha'tica,** Hook. (*P. Rugelii*, Decaisne, in Macoun's Catalogue.) Resembling small forms of No. 1, but *pod 4-seeded.*

3. **P. lanceola'ta,** L. (RIB-GRASS. ENGLISH PLANTAIN.) *Spike thick and dense, short.* Leaves 3–5-ribbed, lanceolate or lanceolate-oblong. Scape grooved, long and slender.—Dry fields and banks.

4. **P. corda'ta,** Lam. Tall and glabrous. *Bracts round-ovate, fleshy.*—Pod 2–4-seeded.—South-western Ontario.

5. **P. marit'ima,** L., var. **juncoi'des,** Gr., with very narrow and slender spike, and linear fleshy leaves, is found on the seacoast and Lower St. Lawrence.

ORDER LV. PRIMULA'CEÆ. (PRIMROSE FAMILY.)

Herbs with regular perfect flowers, well marked by having *a stamen before each petal or lobe of the corolla* and inserted on the tube. Ovary 1-celled, the placenta rising from the base. Style 1; stigma 1.

Synopsis of the Genera.

1. **Prim'ula.** Leaves all in a cluster at the root. Flowers in an umbel at the summit of a simple scape. Corolla salver-shaped. Stamens 5, included.

2. **Trienta'lis.** Leaves in a whorl at the summit of a slender erect stem. Calyx usually 7-parted, the lobes pointed. Corolla usually 7-parted, spreading, without a tube. Filaments united in a ring below. Flowers usually only one, white and star-shaped.

3. **Lysimach'ia.** Leafy-stemmed. Flowers yellow, axillary or in a terminal raceme. Calyx usually 5-parted. Corolla wheel-shaped, mostly 5-parted, and sometimes polypetalous.

4. **Anagal'lis.** Low and spreading. Leaves opposite or whorled, entire. Flowers variously coloured, solitary in the axils. Calyx 5-parted. Corolla wheel-shaped, 5-parted. Filaments bearded.

5. **Sam'olus.** Smooth and spreading, 6–10 inches high. Corolla bell-shaped, 5-parted, with 5 sterile filaments in the sinuses. *Calyx partially adherent to the ovary.* Flowers very small, white, racemed. *Leaves alternate.*

1. PRIM'ULA, L. PRIMROSE. COWSLIP.

1. **P. farino'sa,** L. (BIRD'S-EYE P.) Lower surface of the leaves covered with a white mealiness. Corolla lilac with a yellow centre.—Shores of Lake Huron, and northward.

2. **P. Mistassin'ica,** Michx. Leaves not mealy. Corolla flesh-coloured, the lobes obcordate.—Shores of the Upper Lakes, and northward.

2. TRIENTA'LIS, L. CHICKWEED-WINTERGREEN.

T. America'na, Pursh. (STAR-FLOWER.) Leaves thin and veiny, lanceolate, tapering towards both ends. Petals pointed. —Moist woods.

3. LYSIMACH'IA, Tourn. LOOSESTRIFE.

1. **L. thyrsiflo'ra,** L. (TUFTED LOOSESTRIFE.) Flowers in spike-like clusters from the axils of a few of the upper leaves. Petals lance-linear, *purplish-dotted*, as many minute teeth between them. Leaves scale-like below, the upper lanceolate, opposite, sessile, dark-dotted.—Wet swamps.

2. **L. stricta,** Ait. Flowers on slender pedicels *in a long terminal raceme.* Petals lance-oblong, streaked with dark lines. *Leaves opposite,* lanceolate, acute at each end, sessile, dark-dotted. —Low grounds.

3. **L. quadrifo'lia,** L. *Flowers on long slender peduncles from the axils of the upper leaves.* Petals streaked. *Leaves in whorls* of 4 or 5, ovate-lanceolate, dark-dotted.—Sandy soil.

4. **L. cilia'ta,** L. (*Steironema ciliatum,* Raf., in Macoun's Catalogue.) Flowers nodding on slender peduncles from the upper axils. *Petals not streaked or dotted.* Leaves opposite, *not*

dotted, ovate-lanceolate, pointed, cordate at the base, *on long fringed petioles.*—Low grounds.

5. **L. longifo'lia,** Walt. (*Steironema longifolium*, Gray, in Macoun's Catalogue.) Petals not streaked or dotted. *Stem-leaves sessile, narrowly linear, 2–4 inches long,* the margins sometimes revolute. Stem 4-angled.—Moist soil, western Ontario.

4. ANAGAL'LIS, Tourn. PIMPERNEL.

A. arven'sis, L. (COMMON PIMPERNEL.) Petals obovate, *fringed with minute teeth,* mostly bluish or purplish. Flowers closing at the approach of rain. Leaves ovate, sessile.—Sandy fields and garden soil.

5. SAM'OLUS, L. WATER-PIMPERNEL. BROOK-WEED.

S. Valeran'di, L., var. **America'nus,** Gray. Stem slender, diffusely branched. The slender pedicels each with a bractlet at the middle.—Wet places.

ORDER LVI. LENTIBULA'CEÆ. (BLADDERWORT F.)

Small aquatic or marsh herbs, with a 2-lipped calyx and a personate corolla with a spur or sac underneath. Stamens 2. Ovary as in Primulaceæ. Chiefly represented by the two following genera :—

1. UTRICULA'RIA, L. BLADDERWORT.

1. **U. vulga'ris,** L. (GREATER BLADDERWORT.) Immersed leaves crowded, finely dissected into capillary divisions, furnished with small air-bladders. Flowers yellow, several in a raceme on a naked scape. Corolla closed; the spur conical and shorter than the lower lip.—Ponds and slow waters.

2. **U. interme'dia,** Hayne. Immersed leaves 4 or 5 times forked, the divisions linear-awl-shaped, minutely bristle-toothed on the margin, *not bladder-bearing,* the bladders being on leafless branches. Stem 3–6 inches long. Scape very slender, 3–6 inches long, bearing few yellow flowers. Upper lip of the corolla much longer than the palate; *the spur closely pressed to the broad lower lip.*—Shallow waters.

3. **U. cornu'ta,** Michx., with an awl-shaped spur turned downward and outward, and the lower lip of the corolla helmet-shaped,

is not uncommon in the northern parts of Ontario. Flowers yellow. Leaves awl-shaped.

2. **PINGUIC'ULA**, L. BUTTERWORT.

P. vulga'ris, L. A small and stemless perennial growing on damp rocks. Scapes 1-flowered. Leaves entire, ovate or elliptical, soft-fleshy, clustered at the root. Upper lip of the calyx 3-cleft, the lower 2-cleft. Corolla violet, the lips very unequal, the palate open, and hairy or spotted.—Shore of Lake Huron.

ORDER LVII. OROBANCHA'CEÆ. (BROOMRAPE F.)

Parasitic herbs, destitute of green foliage. Corolla more or less 2-lipped. Stamens didynamous. Ovary 1-celled with 2 or 4 parietal placentæ, many-seeded.

1. **EPIPHE'GUS**, Nutt. BEECH-DROPS.

E. Virginia'na, Bart. A yellowish-brown branching plant, parasitic on the roots of beech-trees. Flowers racemose or spiked; the upper sterile, with long corolla; the lower fertile, with short corolla.

2. **CONOPH'OLIS**, Wallroth. SQUAW-ROOT.

C. America'na, Wallroth. A chestnut-coloured or yellow plant found in clusters in oak woods in early summer, 3–6 inches high and rather less than an inch in thickness. The stem covered with fleshy scales so as to resemble a cone. Flowers under the upper scales; stamens projecting.

3. **APHYL'LON**, Mitchell. NAKED BROOM-RAPE.

A. uniflo'rum, Torr. and Gr. Plant yellowish-brown. Flower solitary at the top of a naked scape. Stem subterranean or nearly so, short and scaly. Scapes 3–5 inches high. Calyx 5-cleft, the divisions lance-awl-shaped. Corolla with a long curved tube and 5-lobed border, and 2 yellow-bearded folds in the throat. Stigma 2-lipped.—Woods, in early summer.

ORDER LVIII. SCROPHULARIA'CEÆ. (FIGWORT F.)

Herbs, distinguished by a 2-lipped or more or less irregular corolla, stamens usually 4 and didynamous, or only 2, (or in Verbascum 5) and a 2-celled and usually many-seeded ovary. Style 1; stigma entire or 2-lobed.

Synopsis of the Genera.

* *Corolla wheel-shaped, and only slightly irregular.*

1. **Verbas'cum.** *Stamens (with anthers) 5.* Flowers in a long terminal spike. Corolla 5-parted, nearly regular. Filaments (or some of them) woolly.

2. **Veron'ica.** *Stamens only 2;* filaments long and slender. Corolla mostly 4-parted, nearly or quite regular. Pod flattish. Flowers solitary in the axils, or forming a terminal raceme or spike.

* * *Corolla 2-lipped, or tubular and irregular.*

+ *Upper lip of the corolla embracing the lower in the bud, except occasionally in* **Mimulus.**

3. **Lina'ria.** *Corolla personate* (Fig. 181, Part I.), *with a long spur beneath.* Stamens 4. Flowers yellow, in a crowded raceme.

4. **Scrophula'ria.** Corolla tubular, somewhat inflated, 5-lobed; *the 4 upper lobes erect,* the lower one spreading. Stamens with anthers 4, the rudiment of a fifth in the form of a scale on the upper lip of the corolla. Flowers small and dingy, forming a narrow terminal panicle. Stem 4-sided.

5. **Chelo'ne.** Corolla inflated-tubular (Fig. 180, Part I.). Stamens 4, with woolly filaments and anthers, and a fifth filament without an anther. Flowers white, in a close terminal spike.

6. **Pentste'mon.** Corolla 2-lipped, gradually widening upwards. Stamens 4, with a fifth sterile filament, *the latter yellow-bearded.* Flowers white or purplish, in a loose panicle.

7. **Mim'ulus.** *Calyx 5-angled* and 5-toothed. Upper lip of the corolla erect or reflexed-spreading, the lower spreading, 3-lobed. Stamens 4, alike; *no rudiment of a fifth.* Stigma 2-lipped. Flowers blue or yellow, solitary on axillary peduncles.

8. **Grati'ola.** Corolla tubular and 2-lipped. *Stamens with anthers only 2,* included. Flowers with a yellowish tube, on axillary peduncles, solitary. Style dilated at the apex.

9. **Ilysan'thes.** Corolla tubular and 2-lipped. *Stamens with anthers only 2,* included; *also a pair of filaments which are two-lobed, but without anthers.* Flowers purplish, axillary. Style 2-lipped at the apex.

+ + *Lower lip of the corolla embracing the upper in the bud.*

10. **Gerar'dia.** Corolla funnel-form, swelling above, *the 5 spreading lobes more or less unequal.* Stamens 4, *strongly didynamous,* hairy. Style long, enlarged at the apex. Flowers purple or yellow, solitary on axillary peduncles, or sometimes forming a raceme.

11. **Castille'ia.** Corolla tubular and 2-lipped, *its tube included in the tubular and flattened calyx;* the upper lip long and narrow and flattened laterally, the lower short and 3-lobed. Stamens 4, didynamous. *Floral leaves scarlet* (rarely yellow) in our species. Corolla pale yellow.

12. **Euphra'sia.** *Calyx 4-cleft.* Upper lip of the corolla erect, the lower spreading. Stamens 4, under the upper lip. Very small herbs, with whitish or bluish spiked flowers. (Chiefly on the sea-coast, and north of Lake Superior.)

13. **Rhinan'thus.** *Calyx flat, greatly inflated in fruit,* 4-toothed. Upper lip of the corolla arched, flat, with a minute tooth on each side below the apex. Stamens 4. Flowers yellow, solitary in the axils, nearly sessile, the whole forming a crowded 1-sided spike. (Chiefly on the sea-coast, and north of Lake Superior.)

14. **Pedicula'ris.** Calyx split in front, not inflated in fruit. Corolla 2-lipped, the upper lip arched or hooded, incurved, flat, 2-toothed under the apex. Stamens 4. *Pod flat, somewhat sword-shaped.*

15. **Melampy'rum.** *Calyx 4-cleft, the lobes sharp-pointed.* Corolla greenish-yellow; upper lip arched, compressed, the lower 3-lobed at the apex. Stamens 4; anthers hairy. Pod 1–4-seeded, flat, oblique. Upper leaves larger than the lower ones and fringed with bristly teeth at the base.

1. VERBAS'CUM, L. MULLEIN.

1. **V. Thap'sus,** L. (COMMON MULLEIN.) A tall and very woolly herb, with the simple stem winged by the decurrent bases of the leaves. Flowers yellow, forming a dense spike.—Fields and roadsides everywhere.

2. **V. Blatta'ria,** L. (MOTH M.) Stem slender, *nearly smooth.* Lower leaves petioled, doubly serrate; the upper partly clasping. Flowers whitish with a purple tinge, *in a loose raceme. Filaments all violet-bearded.*—Roadsides; not common northward.

2. VERON'ICA, L. SPEEDWELL.

1. **V. America'na,** Schweinitz. (AMERICAN BROOKLIME.) Flowers pale blue, in *opposite* axillary racemes. *Leaves mostly petioled,* thickish, serrate. *Pod swollen.*—A common plant in brooks and ditches.

2. **V. Anagal'lis,** L., (WATER SPEEDWELL) is much like No. 1, but *the leaves are sessile,* with a heart-shaped base.

3. **V. scutella'ta,** L. (MARSH S.) Flowers pale blue, in racemes chiefly from *alternate* axils. *Leaves sessile,* linear, opposite, hardly toothed. Racemes 1 or 2, *slender and zigzag. Flowers few.* Pods very flat, notched at both ends.—Bogs.

4. **V. officina'lis,** L. (COMMON S.) Flowers light blue. Stem prostrate, rooting at the base, *pubescent.* Leaves short-petioled,

obovate-elliptical, serrate. *Racemes dense*, chiefly from alternate axils. Pod obovate-triangular, notched.—Hillsides and open woods.

5. **V. serpyllifo'lia,** L. (THYME-LEAVED S.) Flowers whitish or pale blue, in a loose *terminal* raceme. Stem nearly smooth, branched at the creeping base. Leaves obscurely crenate, *the lowest petioled.* Pod flat, notched.—Roadsides and fields. Plant only 2 or 3 inches high.

6. **V. peregri'na,** L. (NECKWEED.) Flowers whitish, *solitary in the axils of the upper leaves.* Whitish corolla, shorter than the calyx. Stem 4–9 inches high, *nearly smooth. Pod orbicular,* slightly notched.—Waste places and cultivated grounds.

7. **V. arven'sis,** L. (CORN SPEEDWELL.) Flowers (blue) as in No. 6, but *the stem is hairy*, and the *pod inversely heart-shaped.*—Cultivated soil.

3. LINA'RIA, Tourn. TOAD-FLAX.

L. vulga'ris, Mill. (TOAD-FLAX. BUTTER-AND-EGGS.) Leaves crowded, linear, pale green. Corolla pale yellow, with a deeper yellow or orange-coloured palate.—Roadsides.

4. SCROPHULA'RIA, Tourn. FIGWORT.

S. nodo'sa, L. Stem smooth, 3–4 feet high. Leaves ovate or oblong, the upper lanceolate, serrate.—Damp thickets.

5. CHELO'NE, Tourn. TURTLE-HEAD.

C. glabra, L. Stem smooth, erect and branching. Leaves short-petioled, lance-oblong, serrate, opposite. Bracts of the flowers concave.—Wet places.

6. PENTSTE'MON, Mitchell. BEARD-TONGUE.

P. pubes'cens. Stem 1–3 feet high, pubescent; the panicle more or less clammy. Throat of the corolla almost closed. Stem-leaves lanceolate, clasping.—Dry soil.

7. MIM'ULUS, L. MONKEY-FLOWER.

1. **M. rin'gens,** L. Stem square, 1–2 feet high. *Corolla blue,* an inch long. (A white-flowered variety is sometimes met with.) Leaves oblong or lanceolate, clasping.—Wet places.

2. **M. Jamesii**, Torr. Stem creeping at the base. *Corolla yellow*, small. Leaves roundish or kidney-shaped, nearly sessile. Calyx inflated in fruit.—In cool springs.

8. **GRATI'OLA**, L. HEDGE-HYSSOP.

1. **G. Virginia'na**, L. Stem 4–6 inches high, clammy with minute pubescence above. *Sterile filaments minute or none.* Leaves lanceolate. Peduncles slender.—Moist places.

2. **G. au'rea**, Muhl. *Nearly glabrous.* Sterile filaments slender, tipped with a little head. *Corolla golden yellow.*

9. **ILYSAN'THES**, Raf. FALSE PIMPERNEL.

I. gratioloi'des, Benth. Stem 4–8 inches high, much branched, diffusely spreading. Leaves ovate, rounded or oblong, the upper partly clasping.—Wet places.

10. **GERAR'DIA**, L. GERARDIA.

1. **G. purpu'rea**, L. (PURPLE GERARDIA.) Corolla rose-purple. Leaves linear, acute, rough-margined. *Flowers an inch long, on short peduncles.*—Low grounds.

2. **G. tenuifo'lia**, Vahl. (SLENDER G.) Corolla rose-purple. Leaves linear, acute. *Flowers about ½ an inch long, on long thread-like peduncles.*—Dry woods.

3. **G. fla'va**, L. (DOWNY G.) Corolla yellow, woolly inside. Stem 3–4 feet high, *finely pubescent.* Leaves oblong or lance-shaped, the upper entire, the lower usually more or less pinnatifid, downy-pubescent.—Woods.

4. **G. quercifo'lia**, Pursh. (SMOOTH G.) Corolla yellow, woolly inside. Stem 3–6 feet high, *smooth and glaucous.* Lower leaves twice-pinnatifid, the upper pinnatifid or entire, smooth.—Woods.

5. **G. pedicula'ria**, L. (CUT-LEAVED G.) Nearly smooth. Flowers nearly as in Nos. ? and 4. Stem 2–3 feet high, very leafy, much branched. Leaves pinnatifid, *the lobes cut and toothed.*—Thickets.

11. **CASTILLE'IA**, Mutis. PAINTED-CUP.

C. coccin'ea, Spreng. (SCARLET PAINTED-CUP.) Calyx 2-cleft, yellowish. Stem pubescent or hairy, 1–2 feet high. The stem-leaves nearest the flowers 3-cleft, the lobes toothed, *bright scarlet.* (A yellow-bracted form occurs on the shore of Lake Huron.) —Sandy soil.

12. EUPHRA'SIA, Tourn. EYEBRIGHT.

E. officina'lis, L., is rather common on the Lower St. Lawrence and the sea-coast. Lowest leaves crenate, those next the flowers *bristly-toothed.*

13. RHINAN'THUS, L. YELLOW-RATTLE.

R. Crista-galli, L. (COMMON YELLOW-RATTLE.) Localities much the same as those of Euphrasia. Seeds broadly winged, rattling in the inflated calyx when ripe.

14. PEDICULA'RIS, Tourn. LOUSEWORT.

1. **P. Canadensis,** L. (COMMON LOUSEWORT. WOOD BETONY.) Stems clustered, simple, hairy. Lowest leaves pinnately-parted. Flowers in a short spike.—Copses and banks.

2. **P. lanceola'ta,** Michx., has a nearly simple, smooth, upright stem, and oblong-lanceolate cut-toothed leaves. Calyx 2-lobed, leafy-crested. Pod ovate.—Grassy swamps.

15. MELAMPY'RUM, Tourn. COW-WHEAT.

M. America'num, Michx. Leaves lanceolate, short-petioled; the lower ones entire.—Open woods.

ORDER LIX. VERBENA'CEÆ. (VERVAIN FAMILY.)

Herbs (with us), with opposite leaves, didynamous stamens, and corolla either irregularly 5-lobed or 2-lipped. Ovary in Verbena 4-celled (when ripe splitting into 4 nutlets) and in Phryma 1-celled, *but in no case 4-lobed*, thus distinguishing the plants of this Order from those of the next.

Synopsis of the Genera.

1. **Verbe'na.** Flowers in spikes. Calyx tubular, 5-ribbed. Corolla tubular, salver-form, the border rather irregularly 5-cleft. Fruit splitting into 4 nutlets.
2. **Phry'ma.** Flowers in loose slender spikes, *reflexed in fruit.* Calyx cylindrical, 2-lipped, the upper lip of three slender teeth. Corolla 2-lipped. Ovary 1-celled and 1-seeded.

1. VERBE'NA, L. VERVAIN.

1. **V. hasta'ta,** L. (BLUE VERVAIN.) Stem 3–5 feet high. Leaves oblong-lanceolate, taper-pointed, serrate. Spikes of *purple* flowers dense, erect, corymbed or panicled.—Low meadows and fields.

2. **V. urticifo'lia,** L. (NETTLE-LEAVED V.) Stem tall. Leaves oblong-ovate, acute, coarsely serrate. Spikes of small *white* flowers very slender, loosely panicled.—Fields and roadsides.

3. **V. angustifo'lia,** Michx. Stem *low.* Leaves narrowly lanceolate, tapering at the base, sessile, roughish, slightly toothed. Flowers purple, in a crowded spike.—Dry soil.

2. PHRY'MA, L. LOPSEED.

P. Leptostach'ya, L. Corolla purplish or pale rose-coloured. Stem slender and branching, 1–2 feet high. Leaves ovate, coarsely toothed.—Woods and thickets.

ORDER LX. LABIA'TÆ. (MINT FAMILY.)

Herbs with square stems, opposite leaves (mostly aromatic), didynamous (or in one or two genera *diandrous*) stamens, a 2-lipped or irregularly 4- or 5-lobed corolla, and a *deeply 4-lobed ovary*, forming in fruit 4 nutlets or achenes. (See Part I., Section 65, for description of a typical plant.)

Synopsis of the Genera.

** Stamens 4, curved upwards, parallel, exserted from a deep notch on the upper side of the 5-lobed corolla.*

1. **Teu'crium.** Calyx 5-toothed. The four upper lobes of the corolla nearly equal, *with a deep notch between the upper 2;* the lower lobe much larger. Flowers pale purple.

2. **Isan'thus.** Calyx bell-shaped, 5-cleft, almost equalling the small pale-blue corolla. Lobes of the corolla *almost equally spreading.* Stamens only slightly exserted.

** * Stamens 4, the outer or lower pair longer, or only 2 with anthers, straight and not converging in pairs! Anthers 2-celled!*

← Corolla almost equally 4-lobed, quite small.

3. **Men'tha.** Calyx equally 5-toothed. Upper lobe of the corolla rather the broadest, and sometimes notched. *Stamens 4,* of equal length, not convergent. Flowers either in terminal spikes or in head-like whorled clusters, often forming interrupted spikes. Corolla purplish or whitish.

4. **Lyc'opus.** Calyx-teeth 4 or 5. *Stamens 2*, the upper pair, if any, without anthers. Flowers white, in dense axillary clusters.

+ + *Corolla evidently 2-lipped, but the lobes nearly equal in size; the tube not bearded inside. Stamens with anthers 2.*

5. **Hedeo'ma.** Calyx 2-lipped, bulging on the lower side at the base, hairy in the throat; 2 stamens with good anthers, *and 2 sterile filaments with false anthers.* Low odorous plants, with bluish flowers in loose axillary clusters.

+ + + *Corolla 2-lipped, the lower of the 5 lobes much larger than the other 4; the tube with a bearded ring inside. Stamens 2 (occasionally 4), much exserted.*

6. **Collinso'nia.** Calyx ovate, enlarged and turned down in fruit, 2-lipped. Corolla elongated, the lower lip toothed or fringed. Strong-scented plants with *yellowish flowers on slender pedicels* in terminal panicled racemes.

+ + + + *Corolla evidently 2-lipped. Stamens with anthers 4.*

7. **Pycnan'themum.** Calyx short-tubular, 10–13-nerved, equally 5-toothed. The whitish or purplish flowers in *small dense* heads, forming terminal corymbs. Aromatic plants, with narrow rigid leaves crowded and and clustered in the axils.

8. **Sature'ia.** Calyx bell-shaped, not hairy in the throat, equally 5-toothed. Aromatic plants, with narrow leaves and purplish spiked flowers.

* * * *Stamens only 2, parallel; the anthers only 1-celled. Corolla 2-lipped.*

9. **Monar'da.** Calyx tubular, nearly equally 5-toothed, hairy in the throat. Corolla elongated, strongly 2-lipped, the upper lip narrow. Stamens with long protruding filaments, each bearing a linear anther on its apex. Flowers large, in whorled heads surrounded by bracts.

* * * * *Stamens 4, the upper or inner pair longer! Anthers approximate in pairs. Corolla 2-lipped.*

10. **Nep'eta.** Calyx obliquely 5-toothed. Anthers approaching each other in pairs under the inner lip of the corolla, the cells of each anther divergent. (See Figs. 59 and 60, Part I.)

11. **Lophan'thus.** Calyx obliquely 5-toothed. Stamens exserted, the upper pair declined, the lower ascending, so that *the pairs cross.* Anther-cells *nearly parallel.* Tall herbs with small flowers in interrupted terminal spikes.

12. **Calamin'tha.** Calyx tubular, 2-*lipped*, often bulging below. Corolla 2-lipped, *the upper lip not arched*, the throat inflated. Flowers pale purple, in globular more or less dense clusters which are crowded with linear or awl-shaped hairy bracts.

* * * * * *Stamens 4, the lower or outer pair longer! Anthers approximate in pairs. Corolla 2-lipped.*

13. **Physoste'gia.** Calyx not 2-lipped, 5-toothed or lobed, thin and membranaceous, inflated-bell-shaped in fruit. Anther-cells parallel. Flowers

large and showy, rose-colour variegated with purple, opposite, in terminal leafless spikes.

14. **Brunel'la.** *Calyx 2-lipped*, flat on the upper side, closed in fruit; *the upper lip 3-toothed, the lower 2-cleft.* Filaments 2-toothed at the apex, the lower tooth bearing the anther. Flowers violet, in a close terminal spike or head which is very leafy-bracted.

15. **Scutella'ria.** *Calyx 2-lipped*, short, closed in fruit, the lips rounded and entire, *the upper with a projection on the back.* Corolla blue or violet, the tube elongated and somewhat curved. Anthers of the lower stamens 1-celled, of the upper 2-celled. Flowers solitary in the axils of the upper leaves, or in axillary or terminal 1-sided racemes.

16. **Marru'bium.** *Calyx 10-toothed*, the teeth spiny and recurved after flowering. Stamens 4, *included in the corolla tube. Whitish woolly plants* with small white flowers in head-like whorls.

17. **Galeop'sis.** Calyx 5-toothed, the teeth spiny. The middle lobe of the lower lip of the corolla inversely heart-shaped, *the palate with 2 teeth at the sinuses.* Stamens 4, *the anthers opening cross-wise.* Flowers purplish, in axillary whorls.

18. **Stach'ys.** Calyx 5-toothed, beset with stiff hairs, the teeth spiny, diverging in fruit. Stamens 4, *the outer pair turned down after discharging their pollen.* Flowers purple, crowded in whorls, these at length forming an interrupted spike.

19. **Leonu'rus.** Calyx 5-toothed, the teeth spiny, and spreading when old. The middle lobe of the lower lip of the corolla inversely heart-shaped. Flowers pale purple, in close whorls in the axils of the *cut-lobed leaves.*

1. TEU'CRIUM, L. GERMANDER.

T. Canadense, L. (AMERICAN GERMANDER. WOOD SAGE.) Stem 1–3 feet high, downy. Leaves ovate-lanceolate, serrate, short-petioled, hoary beneath. Flowers in a long spike.—Low grounds.

2. ISAN'THUS, Michx. FALSE PENNYROYAL.

I. cæru'leus, Michx. A low, branching, clammy-pubescent annual. Leaves lance-oblong, 3-nerved, nearly entire. Peduncles axillary, 1–3-flowered.—Gravelly soil.

3. MEN'THA, L. MINT.

1. **M. vir'idis,** L. (SPEARMINT.) *Flowers in a narrow terminal spike.* Leaves ovate-lanceolate, wrinkled-veiny, unequally serrate, *sessile.*—Wet places.

2. **M. piperi'ta,** L. (PEPPERMINT.) *Flowers in loose interrupted spikes.* Leaves ovate or ovate-oblong, acute, *petioled.* Plant smooth.—Wet places.

3. **M. Canadensis**, L. (Wild Mint.) *Flowers in axillary whorled clusters*, the uppermost axils without flowers. Stem more or less hairy, with ovate or lanceolate toothed leaves on short petioles. Var. **glabra'ta**, Benth., is smoothish, and has a rather pleasanter odour.—Shady wet places. M 9

4. LYC'OPUS, L. Water Horehound.

1. **L. Virgin'icus**, L. (Bugle-Weed.) *Calyx-teeth 4, bluntish.* Stems obtusely 4-angled, 6–18 inches high, producing slender runners from the base. Leaves ovate-lanceolate, toothed.—Moist places.

2. **L. Europæ'us**, L., var. **sinua'tus**, Gray. *Calyx-teeth 5, sharp-pointed.* Stem sharply 4-angled, 1–3 feet high. Leaves varying from cut-toothed to pinnatifid.—Wet places.

5. HEDEO'MA, Pers. Mock Pennyroyal.

1. **H. pulegioi'des**, Pers. (American Pennyroyal.) Stem 5–8 inches high, branching, hairy. Leaves oblong-ovate, *petioled*, obscurely serrate. Whorls few-flowered. Plant with a pungent aromatic odour.—Open woods and fields.

2. **H. his'pida**, Pursh., has the leaves *sessile, linear, and entire*, and the calyx *ciliate and hispid.*—Not common.

6. COLLINSO'NIA, L. Horse-balm.

C. Canaden'sis, L. (Rich-weed. Stone-root.) Stem smooth or nearly so, 1–3 feet high. Leaves serrate, pointed, petioled, 3–6 inches long.—Rich woods.

7. PYCNAN'THEMUM, Michx. Mountain Mint. Basil.

P. lanceola'tum, Pursh. Stem 2 feet high, smoothish or minutely pubescent. Leaves lanceolate or lance-linear. Heads downy. Calyx-teeth short. Lips of the corolla very short.—Dry soil.

8. SATURE'IA, L. Savory.

S. horten'sis, L. (Summer Savory.) Stem pubescent. Clusters few-flowered.—Escaped from gardens in a few localities.

9. MONAR'DA, L. Horse-Mint.

1. **M. did'yma**, L. (Oswego Tea.) *Corolla bright red*, very showy. The large outer bracts tinged with red.—Along shaded streams.

S 94 2. **M. fistulo'sa,** L. (WILD BERGAMOT.) *Corolla purplish.* The outer bracts somewhat purplish.—Dry and rocky banks and woods.

10. NEP'ETA, L. CAT-MINT.

1. **N. Cata'ria,** L. (CATNIP.) Flowers in cymose clusters. Stem erect, downy, branching. Leaves oblong, crenate, whitish beneath. Corolla dotted with purple.—Roadsides.

2. **N. Glecho'ma,** Benth. (GROUND IVY.) *Creeping and trailing.* Leaves *round-kidney-shaped*, crenate, green both sides. Corolla light blue.—Damp waste grounds.

11. LOPHAN'THUS, Benth. GIANT HYSSOP.

1. **L. nepetoi'des,** Benth. Smooth or nearly so, coarsely crenate-toothed. Calyx-teeth ovate, rather obtuse. Corolla greenish-yellow.—Borders of woods.

2. **L. scrophulariæfo'lius,** Benth., has lanceolate calyx-teeth and a purplish corolla.—Near Queenston Heights.

12. CALAMIN'THA, Mœnch. CALAMINTH.

1. **C. Clinopo'dium,** Benth. (BASIL.) Stem hairy, erect, 1–2 feet high. Flower-clusters *dense.* Leaves ovate, nearly entire, petioled.—Thickets and waste places.

2. **C. Nuttallii,** Benth. Smooth, 5–9 inches high. Leaves narrowly oblong. Clusters *few-flowered*, the flowers on slender naked pedicels. Bracts linear or oblong.—Wet limestone rocks, western and south-western Ontario.

13. PHYSOSTE'GIA, Benth. FALSE DRAGON-HEAD.

P. Virginia'na, Benth. Stem smooth, wand-like. Lower leaves oblong-ovate, upper lanceolate. Corolla an inch long, funnel-form, the throat inflated; upper lip slightly arching, the lower 3-parted, spreading, small.—Wet banks; not common.

14. BRUNEL'LA, Tourn. SELF-HEAL.

B. vulga'ris, L. (COMMON HEAL-ALL.) A low plant with oblong-ovate petioled leaves. Clusters 3-flowered, the whole forming a close terminal elongated head. Woods and fields everywhere.

15. SCUTELLA'RIA, L. Skull-cap.

1. **S. galericula'ta**, L. Flowers blue, $\frac{3}{4}$ of an inch long, solitary in the axils of the upper leaves. Stem nearly smooth, 1–2 feet high.—Wet places.

2. **S. par'vula**, Michx. Flowers blue, $\frac{1}{4}$ of an inch long, solitary in the upper axils. Stem *minutely downy*, 3–6 inches high. Lowest leaves round-ovate, the upper narrower, all *entire.*—Dry banks.

3. **S. lateriflo'ra**, L. Flowers blue, $\frac{1}{3}$ of an inch long, in 1-sided racemes. Stem upright, much branched, 1–2 feet high.—Wet places.

16. MARRU'BIUM, L. Horehound.

M. vulga're, L. Leaves round-ovate, crenate-toothed. Calyx with 5 long and 5 short teeth, recurved.—Escaped from gardens in some places.

17. GALEOP'SIS, L. Hemp-Nettle.

G. Tetra'hit, L. (Common Hemp-Nettle.) Stem bristly-hairy, swollen below the joints. Leaves ovate, coarsely serrate. Corolla often with a purple spot on the lower lip.—Waste places and fields.

18. STACH'YS, L. Hedge-Nettle.

S. palustris, L., var. **as'pera**, Gray. Stem 2–3 feet high, 4-angled, the angles beset with stiff reflexed hairs or bristles.—Wet grounds.

19. LEONU'RUS, L. Motherwort.

L. Cardi'aca, L. (Common Motherwort.) Stem tall. Leaves long-petioled, the lower palmately lobed, the upper 3-cleft. Upper lip of the corolla bearded.—Near dwellings.

Order LXI. BORRAGINA'CEÆ. (Borage Family.)

Herbs, with a deeply 4-lobed ovary, forming 4 seed-like nutlets, as in the last Order, *but the corolla is regularly 5-lobed, with 5 stamens inserted upon its tube.*

Synopsis of the Genera.

* *Corolla without any scales in the throat.*

1. **E'chium.** Corolla with a funnel-form tube and a spreading border of 5 *somewhat unequal lobes. Stamens exserted, unequal.* Flowers bright blue with a purplish tinge, in racemed clusters. Plant bristly.

* * *Corolla with 5 scales completely closing the throat.*

2. **Sym'phytum.** Corolla tubular-funnel form with short spreading lobes *scales awl-shaped. Flowers yellowish-white*, in nodding raceme-like clusters, the latter often in pairs. *Nutlets smooth.* Coarse hairy herbs.

3. **Echinosper'mum.** *Nutlets prickly on the margin.* Corolla salver-shaped, the lobes rounded; scales short and blunt. *Flowers blue*, small, in leafy-bracted racemes. Plant rough-hairy.

4. **Cynoglos'sum.** *Nutlets prickly all over.* Corolla funnel-form; scales blunt. Flowers red-purple or pale blue, in racemes which are naked above, but usually leafy-bracted below. Strong-scented coarse herbs.

* * * *Corolla open, the scales or folds not sufficient to completely close the throat. Nutlets smooth.*

5. **Onosmo'dium.** Corolla tubular, *the 5 lobes acute and erect or converging.* Anthers mucronate; filaments very short. Style thread-form, much exserted. Flowers greenish or yellowish-white. Rather tall stout plants, shaggy with spreading bristly hairs, or rough with short appressed bristles.

6. **Lithosper'mum.** Corolla funnel-form or salver-shaped, the 5 lobes of the spreading limb rounded. Anthers almost sessile. Root mostly red. Flowers small and almost white, or large and deep yellow, scattered or spiked and leafy-bracted.

7. **Myoso'tis.** Corolla salver-shaped, with a very short tube, *the lobes convolute in the bud;* scales or appendages of the throat blunt and arching. Flowers blue, in (so-called) racemes without bracts. Low plants, mostly soft-hairy.

1. E'CHIUM, Tourn. VIPER'S BUGLOSS.

E. vulga're, L. (BLUE-WEED.) Stem erect, 2 feet high. Leaves sessile, linear-lanceolate. Flowers showy, in lateral clusters, the whole forming a long narrow raceme.—Roadsides; common in eastern Ontario, and rapidly spreading westward.

2. SYM'PHYTUM, Tourn. COMFREY.

S. officina'le, L. (COMMON COMFREY.) Stem winged above by the decurrent bases of the leaves, branched. Leaves ovate-lanceolate or lanceolate.—Moist soil; escaped from gardens.

3. ECHINOSPER'MUM, Swartz. STICKSEED.

E. Lap'pula, L. Lehm. A very common roadside weed, 1–2 feet high, branching above. Leaves lanceolate, rough. Nutlets warty on the back, with a double row of prickles on the margin,

4. CYNOGLOS'SUM, Tourn. Hound's-Tongue.

1. **C. officina'le**, L. (Common Hound's-Tongue.) *Flowers red-purple.* Upper leaves lanceolate, sessile. Stem soft-pubescent. Nutlets rather flat.—A common weed in fields and along roadsides.

2. **C. Virgin'icum**, L. (Wild Comfrey.) *Flowers pale blue.* Stem roughish with spreading hairs. *Leaves few*, lanceolate-oblong, *clasping.* Racemes corymbed, raised on a long naked peduncle.—Rich woods.

3. **C. Moriso'ni**, DC. (*Echinospermum Virginicum*, Lehm., in Macoun's Catalogue.) (Beggar's Lice.) *Flowers pale blue or white.* Stem hairy, *leafy*, with broadly spreading branches. Leaves taper-pointed and tapering at the base. Racemes panicled, forking, widely spreading. Pedicels of the flowers reflexed in fruit.—Open woods and thickets.

5. ONOSMO'DIUM, Michx. False Gromwell.

1. **O. Carolinia'num**, DC. Stem stout, 3–4 feet high. Leaves ovate-lanceolate, acute. *Lobes of the corolla ovate-triangular, very hairy outside.*—Banks of streams.

2. **O. Virginia'num**, DC. Stem slender, 1–2 feet high. Leaves narrowly oblong. *Lobes of the corolla lance-awl-shaped, sparingly bearded outside with long bristles.*—Banks and hillsides; not common.

6. LITHOSPER'MUM, Tourn. Gromwell. Puccoon.

* *Corolla almost white. Nutlets wrinkled, gray.*

1. **L. arven'se**, L. (Corn Gromwell.) Stem 6–12 inches high, erect. Leaves lanceolate or linear.—Sandy banks.

* * *Corolla deep yellow. Nutlets smooth and shining.*

2. **L. hirtum**, Lehm. (Hairy Puccoon.) Stem 1–2 feet high, *hispid.* Stem-leaves lanceolate or linear; those of the flowering branches ovate-oblong, ciliate. Flowers *peduncled. Corolla woolly at the base inside.*—Dry woods.

3. **L. canes'cens**, Lehm. (Hoary Puccoon. Alkanet.) Stem 6–15 inches high, *soft-hairy. Corolla naked at the base inside.* Flowers *sessile.* Limb of the corolla smaller, and the calyx shorter, than in No. 2.—Open woods and plains.

* * * *Corolla greenish-white or cream colour. Nutlets smooth and shining, mostly white.*

4. **L. officina'le,** L. (COMMON GROMWELL.) Much branched above. Leaves broadly lanceolate, acute. *Corolla exceeding the calyx.*—Roadsides and old fields.

5. **L. latifo'lium,** Michx. Loosely branched above. Leaves ovate and ovate-lanceolate, mostly taper-pointed. *Corolla shorter than the calyx.*—Borders of woods.

7. MYOSO'TIS, L. FORGET-ME-NOT.

1. **M. palustris,** Withering, var. **laxa,** Gray. (*Myosotis laxa,* Lehm., in Macoun's Catalogue.) (FORGET-ME-NOT.) Stem ascending from a creeping base, about a foot high, *smoothish,* loosely branched. *Calyx open in fruit.* Corolla pale blue, with a yellow eye. Pedicels spreading.—Wet places.

2. **M. arvensis,** Hoffm. Stem erect or ascending, *hirsute. Calyx closing in fruit.* Corolla blue, rarely white. Pedicels spreading in fruit and longer than the 5-cleft equal calyx. *Racemes naked at the base.*—Fields.

3. **M. verna,** Nutt., differs from the last in having a very small *white* corolla, pedicels *erect* in fruit, and the racemes leafy at the base. The calyx, also, is unequally 5-toothed and hispid. —Dry hills.

ORDER LXII. HYDROPHYLLA'CEÆ. (WATERLEAF F.)

Herbs, with alternate cut-toothed or lobed leaves, and regular pentamerous and pentandrous flowers very much like those of the last Order, *but having a 1-celled ovary with the seeds on the walls* (*parietal*). Style 2-cleft. Flowers mostly in 1-sided cymes which uncoil from the apex. The only common Genus is

HYDROPHYL'LUM, L. WATERLEAF.

1. **H. Virgin'icum,** L. Corolla bell-shaped, the 5 lobes convolute in the bud; the tube with 5 folds down the inside, one opposite each lobe. *Stamens and style exserted, the filaments bearded below.* Stem *smoothish.* Leaves *pinnately* cleft into 5–7 divisions, the latter ovate-lanceolate, pointed, cut-toothed. *Calyx-lobes very narrow, bristly-ciliate.* Flowers white or pale

blue. Peduncles *longer* than the petioles of the upper leaves. Rootstocks scaly-toothed.—Moist woods.

2. **H. Canadense,** L., differs from the last in having the leaves *palmately* 5–7-lobed, and *rounded*; the peduncles *shorter* than the petioles; and the calyx-lobes *nearly smooth.*–Rich woods.

3. **H. appendicula'tum,** Michx. Stem, pedicels, and calyx *hairy.* Stem-leaves palmately 5-lobed and rounded, the lowest leaves pinnately divided. *Calyx with a small reflexed appendage in each sinus.* Stamens sometimes not exserted.—Rich woods.

ORDER LXIII. POLEMONIA'CEÆ. (POLEMONIUM F.)

Herbs, with regular pentamerous and pentandrous flowers, *but a 3-celled ovary and 3-lobed style. Lobes of the corolla convolute in the bud.* Calyx persistent. Represented commonly with us by only one Genus,

PHLOX, L. PHLOX.

1. **P. divarica'ta,** L. Corolla salver-shaped, with a long tube. Stamens short, *unequally inserted.* Stem ascending from a prostrate base, somewhat clammy. Leaves *oblong-ovate.* Flowers lilac or bluish, in a spreading loosely-flowered cyme. *Lobes of the corolla mostly obcordate.*—Moist rocky woods.

2. **P. pilo'sa,** L. Leaves *lanceolate or linear,* tapering to a sharp point. Lobes of the pink-purplé corolla obovate, *entire.*—Southwestern Ontario.

3. **P. subula'ta,** L., the Moss Pink of the gardens, has escaped from cultivation in some places. Stem creeping and tufted in broad mats. Flowers mostly rose-colour.—Dry grounds.

ORDER LXIV. CONVOLVULA'CEÆ. (CONVOLVULUS F.)

Chiefly twining or trailing herbs, with alternate leaves and regular flowers. Sepals 5, imbricated. Corolla 5-plaited or 5-lobed and convolute in the bud. Stamens 5. Ovary 2-celled.

Synopsis of the Genera.

1. **Calyste'gia.** *Calyx enclosed in 2 large leafy bracts.* Corolla funnel-form, the border obscurely lobed. Pod 4-seeded.
2. **Convol'vulus.** *Calyx without bracts.*

3. **Cus'cuta.** *Leafless parasitic slender twiners*, with yellowish or reddish stems, attaching themselves to the bark of other plants. Flowers small, mostly white, clustered. Corolla bell-shaped. *Stamens with a fringed appendage at their base.*

1. CALYSTE'GIA, R. Br. BRACTED BINDWEED.

1. **C. se'pium**, R. Br. (*Convolvulus sepium*, L., in Macoun's Catalogue.) (HEDGE BINDWEED.) *Stem mostly twining.* Leaves halberd-shaped. Peduncles 4-angled. Corolla commonly rose-coloured.—Moist banks.

2. **C. spithamæ'a**, Pursh. (*Convolvulus spithamæus*, L., in Macoun's Catalogue.) Stem low and simple, upright or ascending, *not twining*, 6–12 inches high. Leaves oblong, more or less heart-shaped at the base. Corolla white.—Dry soil.

2. CONVOL'VULUS, L. BINDWEED.

C. arvensis, L. (BINDWEED.) Stem twining or procumbent, and low. Leaves ovate-oblong, sagittate, the lobes acute. Corolla white, or tinged with red.

3. CUS'CUTA, Tourn. DODDER.

C. Grono'vii, Willd. Stems resembling coarse threads, spreading themselves over herbs and low bushes.—Low and moist shady places.

ORDER LXV. SOLANA'CEÆ. (NIGHTSHADE FAMILY.)

Rank-scented herbs (or one species shrubby), with colourless bitter juice, alternate leaves, and regular pentamerous and pentandrous flowers, *but a 2-celled ovary, with the placentæ in the axis.* Fruit a many-seeded berry or pod.

Synopsis of the Genera.

1. **Sola'num.** Corolla wheel-shaped, 5-lobed, the margins turned inward in the bud. *Anthers conniving around the style*, the cells opening by pores at the apex; filaments very short. The larger leaves often with an accompanying smaller one. Fruit a *berry.*

2. **Phys'alis.** Calyx 5-cleft, enlarging after flowering, *becoming at length much inflated, and enclosing the berry.* Corolla between wheel-shaped and funnel-form. *Anthers separate*, opening lengthwise. Plant clammy-pubescent.

3. **Lycium.** Corolla funnel-form or tubular. Fruit a small *berry*, the calyx persistent but *not inflated*. A shrubby plant with long drooping branches and greenish-purple flowers on slender peduncles fascicled in the axils.

4. **Hyoscy'amus.** *Fruit a pod, the top coming off like a lid.* Calyx urn-shaped, 5-lobed, persistent. Corolla funnel-form, *oblique*, the limb 5-lobed, dull-coloured and veiny. Plant clammy-pubescent.

5. **Datu'ra.** Fruit a large prickly naked *pod*. Calyx long, *5-angled*, not persistent. Corolla very large, funnel-form, *strongly plaited* in the bud, with 5 pointed lobes. Stigma 2-lipped. Rank-scented weeds, with the showy flowers in the forks of the branching stems.

6. **Nicotia'na.** Fruit a *pod*, enclosed in the calyx. Calyx tubular-bell-shaped, 5-cleft. Corolla dull greenish-yellow, funnel-form, plaited in the bud. Leaves large. Flowers racemed or panicled.

1. SOLA'NUM, Tourn. NIGHTSHADE.

1. **S. Dulcama'ra,** L. (BITTERSWEET.) Stem somewhat shrubby and *climbing*. Leaves ovate and heart-shaped, *the upper halberd-shaped, or with 2 ear-like lobes at the base.* Flowers violet-purple, in small cymes. *Berries red.*—Near dwellings and in moist grounds.

2. **S. nigrum,** L. (COMMON NIGHTSHADE.) *Stem low and spreading*, branched. *Leaves ovate, wavy-toothed.* Flowers small, white, drooping in umbel-like lateral clusters. *Berries black.*—Fields and damp grounds.

3. **S. rostra'tum,** Dunal, is a *prickly* herb with large yellow flowers and *sharp* anthers.—Ottawa.

2. PHYS'ALIS, L. GROUND CHERRY.

1. **P. visco'sa,** L. (*P. Virginiana*, Mill, in Macoun's Catalogue.) Corolla *greenish-yellow*, brownish in the centre. Anthers yellow. Leaves ovate or heart-shaped, mostly toothed. Berry orange, sticky.—Sandy soil.

2. **P. grandiflo'ra,** Hook. Corolla *white*, large, with a woolly ring in the throat. Anthers tinged with blue or violet.

3. LYCIUM, L. MATRIMONY-VINE.

L. vulga're, Dunal. Common about dwellings. Berry oval, orange-red.

4. HYOSCY'AMUS, Tourn. HENBANE.

H. niger, L. (BLACK HENBANE.) Escaped from gardens in some localities. Corolla dull yellowish, netted with purple veins.

Leaves clasping, sinuate-toothed. A strong-scented and poisonous herb.

5. DATU'RA, L. Stramonium. Thorn-Apple.

1. **D. Stramo'nium**, L. (Common Thorn-Apple.) Stem *green*. Corolla *white*, 3 inches long. Leaves ovate, sinuate-toothed.—Roadsides.

2. **D. Ta'tula**, L. (Purple T.) Stem *purple*. Corolla *pale violet-purple*.

6. NICOTIA'NA, L. Tobacco.

N. rus'tica, L. (Wild Tobacco.) Old fields and in gardens.

Order LXVI. GENTIANA'CEÆ. (Gentian Family.)

Smooth herbs, *distinguished by having a 1-celled ovary with seeds on the walls, either in 2 lines or on the whole inner surface.* Leaves mostly opposite, simple, and sessile, but in one Genus alternate and compound. Stamens as many as the lobes of the regular corolla and alternate with them. Stigmas 2. Calyx persistent. Juice colourless and bitter.

Synopsis of the Genera.

1. **Fra'sera.** Corolla wheel-shaped, 4-parted ; a fringed glandular spot on each lobe. Flowers light greenish-yellow, with small purple-brown spots.
2. **Hale'nia.** Corolla 4-lobed, *the lobes all spurred at the base.* Flowers yellowish or purplish, somewhat cymose.
3. **Gentia'na.** Corolla not spurred, 4–5-lobed, mostly funnel-form or bell-shaped, generally with teeth or folds in the sinuses of the lobes. Stigmas 2, persistent. Pod oblong. Seeds innumerable. Flowers showy, in late summer and autumn.
4. **Menyan'thes.** A bog-plant. Corolla short funnel-form, 5-lobed, *densely white-bearded on the upper face. Leaves alternate, compound, of 3 oval leaflets. The flowers in a raceme at the summit of a naked scape*, white or tinged with pink.
5. **Limnan'themum.** An aquatic, with simple round-heart-shaped floating leaves on long petioles. Corolla white, wheel-shaped, 5-parted, bearded at the base only. Flowers in an umbel borne on the petiole.

1. FRA'SERA, Walt. American Columbo.

F. Carolinien'sis, Walt. Tall and showy. Leaves whorled, mostly in fours. Root thick. Flowers numerous in a pyramidal panicle.—Dry soil.

2. **HALE'NIA**, Borkh. SPURRED GENTIAN.

H. deflex'a, Griseb. Stem erect, 9–18 inches high. Leaves 3–5-nerved, those at the base of the stem oblong-spathulate, petioled ; the upper acute and sessile or nearly so. Spurs of the corolla curved.—Not common in Ontario ; common on the Lower St. Lawrence.

3. **GENTIA'NA**, L. GENTIAN.

1. **G. crini'ta**, Frœl. (FRINGED GENTIAN.) Corolla funnel-form, *4-lobed, the lobes fringed on the margins ;* no plaited folds in the sinuses. *Flowers sky-blue, solitary on long naked stalks* terminating the stem or simple branches. *Ovary lanceolate.* Leaves lance-shaped or ovate-lanceolate.—Low grounds.

2. **G. deton'sa**, Fries., (SMALLER FRINGED G.) is distinguished from No. 1 by the shorter or almost inconspicuous fringe of the corolla, the linear or lance-linear leaves, and the broader ovary.—Moist grounds, chiefly in the Niagara District.

3. **G. quinqueflo'ra**, Lam. (FIVE-FLOWERED G.) Corolla tubular-funnel-form, pale-blue, no folds in the sinuses. Calyx 5-cleft, the lobes awl-shaped. Lobes of the corolla triangular-ovate, bristle-pointed. Anthers separate. Stem slender and branching, a foot high, the branches racemed or panicled, about 5-flowered at the summit.—Dry hill-sides.

4. **G. alba**, Muhl. (WHITISH G.) Corolla inflated-club-shaped, *at length open*, 5-lobed, the lobes about twice as long as the *toothed appendages in the sinuses.* Flowers *greenish-white or yellowish*, sessile, crowded in a terminal cluster. Anthers usually cohering. Leaves lance-ovate, with a clasping heart-shaped base.—Low grounds.

5. **G. Andrews'ii**, Griseb. (CLOSED G.) Corolla inflated-club-shaped, *closed at the mouth*, the apparent lobes being really the large fringed-toothed appendages. *Flowers blue*, in a close sessile terminal cluster. Anthers cohering. Leaves ovate-lanceolate from a narrower base.—Low grounds ; common northward, flowering later than No. 3.

4. **MENYAN'THES**, Tourn. BUCKBEAN.

M. trifolia'ta, L. A common plant in bogs and wet places northward. The bases of the long petioles sheathe the lower part of the scape, or thick rootstock, from which they spring. Plant about a foot high.

5. **LIMNAN'THEMUM**, Gmelin. FLOATING HEART.

L. lacuno'sum, Griseb. In shallow waters, northern Ontario.

ORDER LXVII. APOCYNA'CEÆ. (DOGBANE FAMILY.)

Herbs or slightly shrubby plants, with milky juice, opposite simple entire leaves, and regular pentamerous and pentandrous flowers with the lobes of the corolla convolute in the bud. *Distinguished by having 2 separate ovaries*, but the 2 stigmas united. Calyx free from the ovaries. Anthers converging round the stigmas. Seeds with a tuft of down on the apex. Represented with us only by the Genus

APO'CYNUM, Tourn. DOGBANE.

1. **A. androsæmifo'lium**, L. (SPREADING DOGBANE.) The corolla bell-shaped, 5-cleft, *pale rose-coloured, the lobes turned back. Branches of the stem widely forking.* Flowers in loose rather spreading cymes. Leaves ovate, petioled. Fruit 2 long and slender diverging pods.—Banks and thickets.

2. **A. cannab'inum**, L. (INDIAN HEMP.) Lobes of the *greenish-white* corolla not turned back. *Branches erect.* Cymes closer than in No. 1, and the flowers much smaller.—Along streams.

ORDER LXVIII. ASCLEPIADA'CEÆ. (MILKWEED F.)

Herbs with milky juice and opposite or whorled simple entire leaves. Pods, seeds, and anthers as in the last Order, *but the anthers are more closely connected with the stigma, the (reflexed) lobes of the corolla are valvate in the bud, the pollen is in waxy masses, and the (monadelphous) short filaments bear 5 curious hooded bodies behind the anthers.* Flowers in umbels. Commonly represented by only one Genus, which is typical of the whole Order.

ASCLE'PIAS, L. MILKWEED.

1. **A. Cornu'ti**, Decaisne. (COMMON MILKWEED.) Stem tall and stout. Leaves oval or oblong, short-petioled, pale green, 4–8

inches long. *Flowers dull greenish-purple. Pods ovate, soft spiny, woolly.*—Mostly in dry soil; very common.

2. **A. phytolaccoi'des,** Pursh. (POKE-MILKWEED.) Stem tall and smooth. Leaves broadly ovate, acute at both ends, short-petioled. *Pedicels loose and nodding, very long and slender.* Corolla greenish, *with the hooded appendages white.* Pods minutely downy, *but not warty.*—Moist thickets.

3. **A. incarna'ta,** L. (SWAMP M.) Stem tall, leafy, branching, and smooth. Leaves oblong-lanceolate, acute, obscurely heart-shaped at the base. *Flowers rose-purple. Pods very smooth and glabrous.*—Swamps and low grounds.

4. **A. tubero'sa,** L. (BUTTERFLY-WEED. PLEURISY-ROOT.) Stem very leafy, branching above, rough-hairy. Leaves linear or oblong-lanceolate, chiefly scattered. Corolla greenish-orange, *with the hoods bright orange-red.* Pods hoary. Dry hill-sides and fields; almost destitute of milky juice.

ORDER LXIX. OLEA'CEÆ. (OLIVE FAMILY.)

The only common representative Genus of this Order in Canada is Fraxinus (Ash). The species of this Genus are trees with pinnate leaves, and polygamous or diœcious flowers without petals and mostly also without a calyx; stamens only 2, with large oblong anthers. Fruit a 1–2-seeded samara. Flowers insignificant, from the axils of the previous year's leaves.

FRAX'INUS, Tourn. ASH.

1. **F. America'na,** L. (WHITE ASH.) *Fruit winged from the apex only, the base cylindrical. Branchlets and petioles smooth and glabrous.* Calyx very minute, persistent. Leaflets 7–9, *stalked.*—Rich woods.

2. **F. pubes'cens,** Lam., (RED ASH) has the *branchlets and petioles softly-pubescent,* and the fruit acute at the base, 2-edged, and gradually expanding into the long wing above.—Same localities as in No. 1.

3. **F. sambucifo'lia,** Lam. (BLACK or WATER ASH.) Branchlets and petioles smooth. Leaflets 7–9, *sessile,* serrate. *Fruit winged all round.* Calyx wanting, and the flowers consequently naked.—Swamps.

III. APET'ALOUS DIVISION.

Flowers destitute of corolla and sometimes also of calyx.

ORDER LXX. ARISTOLOCHIA'CEÆ. (BIRTHWORT F.)

Herbs with perfect flowers, *the tube of the 3-lobed calyx adherent to the 6-celled many-seeded ovary.* Leaves heart-shaped or kidney-shaped, on long petioles from a thick rootstock. Stamens 12 or 6. Flowers solitary. Calyx dull-coloured, the lobes valvate in the bud.

AS'ARUM, Tourn. WILD GINGER.

A. Canadense, L. Radiating stigmas 6. Leaves only a single pair, kidney-shaped, and rather velvety, the peduncle in the fork between the petioles, close to the ground. Rootstock aromatic. Calyx brown-purple inside, the spreading lobes pointed.—Rich woods.

ORDER LXXI. PHYTOLACCA'CEÆ. (POKEWEED F.)

Herbs with alternate leaves and perfect flowers, resembling in most respects the plants of the next Order, *but the ovary is composed of several carpels in a ring, forming a berry in fruit.* Only one Genus and one Species.

PHYTOLAC'CA, Tourn. POKEWEED.

P. decan'dra, L. (COMMON POKE.) Calyx of 5 rounded white sepals. Ovary green, of 10 1-seeded carpels united in a ring. Styles 10, short and separate. Stamens 10. Fruit a crimson or purple 10-seeded berry. Stem very tall and stout, smooth. Flowers in long racemes opposite the leaves.—Sandy soil.

ORDER LXXII. CHENOPODIA'CEÆ. (GOOSEFOOT F.)

Homely herbs, with more or less succulent leaves (chiefly alternate), and small greenish flowers mostly in interrupted spikes. Stamens usually as many as the lobes of the calyx and opposite them. Ovary 1-celled and 1-ovuled, forming an achene or utricle in fruit. Stigmas mostly 2.

Synopsis of the Genera.

1. **Chenopo'dium.** Weeds with (usually) mealy leaves, and very small perfect greenish sessile flowers in small panicled spiked clusters. Calyx 5-cleft, more or less enveloping the fruit. Stamens mostly 5; filaments slender.
2. **Bli'tum.** Flowers perfect, in heads which form interrupted spikes. Calyx becoming fleshy and bright red in fruit so that the clusters look something like strawberries. Leaves triangular and somewhat halberd-shaped, sinuate-toothed.
3. **At'riplex.** Flowers *monœcious or diœcious*, the staminate with a regular calyx, in spiked clusters; the pistillate without a calyx, but with a pair of appressed bracts.
4. **Corisper'mum.** Flowers all *perfect*, *single*, and sessile in the axils of the upper leaves, usually forming a spike. *Calyx of a single delicate sepal.* Low herbs, with linear 1-nerved leaves.
5. **Salso'la,** with fleshy awl-shaped sharp-pointed leaves, is not uncommon on the Lower St. Lawrence and the sea-coast.

1. CHENOPO'DIUM, L. GOOSEFOOT. PIGWEED.

1. **C. album,** L. (LAMB'S-QUARTERS.) Stem upright, 1–3 feet high. Leaves varying from rhombic-ovate to lanceolate, more or less toothed, *mealy, as are also the dense flower-clusters.*—Extremely common in cultivated soil.

2. **C. ur'bicum,** L. Rather pale and only slightly mealy, 1–3 feet high, branches *erect.* Leaves triangular, acute, *coarsely and sharply many-toothed.* Spikes *erect*, crowded in a long and narrow racemose panicle.—Waste places in towns.

3. **C. hy'bridum,** L. (MAPLE-LEAVED GOOSEFOOT.) *Bright green.* Stem widely branching, 2–4 feet high. Leaves thin, large, triangular, heart-shaped, sinuate-angled, the angles extended into pointed teeth. Panicles loose, leafless. Plant with a rank unpleasant odour.—Waste places.

4. **C. Bo'trys,** L. (JERUSALEM OAK.) Not mealy, but *sticky;* low, spreading, sweet-scented. Leaves deeply sinuate, *slender-petioled.* Racemes in *loose* divergent corymbs.—Roadsides; escaped from gardens.

5. **C. ambrosioi'des,** L. (MEXICAN TEA.) Not mealy, but sticky. Leaves *slightly* petioled, wavy-toothed or nearly entire. Spikes *densely* flowered.—Streets of towns.

2. BLI'TUM, Tourn. Blite.

B. capita'tum, L. (Strawberry Blite.) Stem ascending, branching. Leaves smooth. The axillary head-like clusters very conspicuous in fruit.—Dry soil, margins of woods, &c.

3. AT'RIPLEX, Tourn. Orache.

A. pat'ula, L. Erect or diffuse, scurfy, green or rather hoary. Leaves varying from triangular or halberd-shaped to lance-linear, petioled.—Streets of towns.

4. CORISPER'MUM, Ant. Juss. Bug-seed.

C. hyssopifo'lium, L. Somewhat hairy when young, pale. Stamens 1 or 2. Styles 2. Fruit oval, flat.—Sandy beaches, western and south-western Ontario.

Order LXXIII. AMARANTA'CEÆ. (Amaranth F.)

Homely weeds, a good deal like the plants of the last Order, *but the flower-clusters are interspersed with dry and chaff-like (sometimes coloured) persistent bracts, usually 3 to each flower.*

Synopsis of the Genera.

1. **Amaran'tus.** Flowers *monœcious or polygamous*, all with a calyx of 3 or 5 distinct erect sepals.
2. **Monte'lia.** Flowers *diœcious;* calyx none in the pistillate flowers.

1. AMARAN'TUS, Tourn. Amaranth.

1. **A. panicula'tus,** L. *Reddish flowers* in terminal and axillary *slender* spikes, the bracts awn-pointed.—In the neighbourhood of gardens.

2. **A. retroflex'us,** L. (Pigweed.) *Flowers greenish,* in spikes forming a stiff panicle. Leaves a dull green, long-petioled, ovate, wavy-margined. *Stem erect.*—Common in cultivated soil.

3. **A. albus,** L. Flowers greenish, in small close axillary clusters. *Stem low and spreading.*—Roadsides.

2. MONTE'LIA, Moquin.

M. tamaris'cina, Gray. A tall smooth herb, with lanceolate or oblong-ovate alternate leaves on long petioles, and small clusters of greenish flowers in interrupted spikes.—Wet places.

ORDER LXXIV. POLYGONA'CEÆ. (BUCKWHEAT F.)

Herbs, *well marked by the stipules of the alternate leaves being in the form of membranous sheaths above the usually swollen joints of the stem.* Flowers usually perfect. Calyx 4–6-parted. Stamens 4–9, inserted on the base of the calyx. Stigmas 2 or 3. Ovary 1-celled, with a single ovule rising from the base, forming a little nutlet.

Synopsis of the Genera.

1. **Polyg'onum.** Sepals 5 (occasionally 4), often coloured and petal-like, *persistent*, embracing the 3-angled (or sometimes flattish) nutlet or achene. Flowers in racemes or spikes, or sometimes in the axils.
2. **Ru'mex.** Sepals 6, *the 3 outer ones herbaceous and spreading in fruit*, the 3 inner (called *valves*) somewhat petal-like and, after flowering, convergent over the 3-angled achene, *often with a grain-like projection on the back.* Stamens 6. Styles 3. Flowers usually in crowded whorls, the latter in panicled racemes.
3. **Fagopy'rum.** Calyx 5-parted, petal-like. Stamens 8, *with 8 yellow glands between them.* Styles 3. Achene 3-angled. Flowers white, in panicles. Leaves triangular heart-shaped or halberd-shaped.

1. POLYG'ONUM, L. KNOTWEED.

* *Flowers along the stem, inconspicuous, greenish-white, nearly sessile in the axils of the small leaves. Sheaths cut-fringed or torn.*

1. **P. avicula're,** L. (KNOTGRASS. GOOSEGRASS.) A weed everywhere in yards and waste places. *Stem prostrate and spreading.* Stamens chiefly 5. Achene 3-sided, *dull.* Stigmas 3. Leaves sessile, lanceolate or oblong. Var. **erectum** is upright and larger, with broader leaves.

2. **P. ten'ue,** Michx. Stem *slender, upright,* sparingly branched. Leaves sessile, *narrowly linear,* very acute. Achene *smooth and shining.*—Dry soil and rocky places.

* * *Flowers in terminal spikes or racemes, mostly rose-coloured or pinkish, occasionally greenish.*

+ *Leaves not heart-shaped or arrow-shaped.*

3. **P. incarna'tum,** Ell. *Sheaths not fringed. Stem nearly smooth,* 3–6 feet high. Leaves long, tapering from near the base to a narrow point, rough on the midrib and margins. *Spikes linear and nodding. Stamens 6. Styles 2. Achene flat or hollow-sided.*—In muddy places along streams and ponds.

4. **P Pennsylva'nicum,** L. Sheaths not fringed. Stem 1–3 feet high, *the upper branches and the peduncles bristly with stalked glands. Spikes thick, erect. Stamens 8.* Achene flat.—Low open grounds.

5. **P. Persica'ria,** L. (LADY'S THUMB.) Sheaths with a somewhat ciliate border. *Stem nearly smooth,* a foot or more in height. *Leaves with a dark blotch on the middle of the upper surface.* Spikes dense, erect, on naked peduncles. Stamens 6. Achene flat or 3-angled, according as the stigmas are 2 or 3.—Very common near dwellings in moist ground.

6. **P. amphib'ium,** L. (WATER PERSICARIA.) Spike of flowers dense, oblong, *showy, rose-red, Stem floating in shallow water* or rooting in soft mud, *nearly glabrous.* Leaves long-petioled, *often floating.* Sheaths not bristly-fringed. *Stamens 5.* Stigmas 2.—In shallow water, mostly northward.

7. **P. Muhlenberg'ii,** Watson, differs from the last in being *rough with appressed hairs* all over.—Ditches.

8. **P. Hartwright'ii,** Gray, is distinguished from P. amphibium by its *foliaceous and ciliate sheaths.*—Muddy margins of ponds and lakes.

9. **P hydropiperoi'des,** Michx. (MILD WATER-PEPPER.) Stem slender, 1–3 feet high, *in shallow water.* Leaves narrow, roughish. *Sheaths hairy and fringed with long bristles.* Spikes slender, erect, pale rose-coloured or whitish. Stamens 8. Stigmas 3. Achene 3-angled.—In shallow water.

10. **P. acre,** H.B K. (WATER SMARTWEED.) Sheaths fringed with bristles. *Leaves transparent-dotted.* Stem rooting at tne decumbent base, 2–4 feet high, *in shallow water or muddy soil.* Leaves narrow, taper-pointed. Spikes slender, *erect,* pale rose-coloured. *Sepals glandular-dotted. Stamens 8.* Achene 3-angled, *shining.*—Muddy soil or shallow water.

11. **P. Hydrop'iper,** L. (COMMON SMARTWEED or WATER-PEPPER.) Sheaths and leaves as in the last, the leaves, however, larger. *Spikes slender, nodding,* greenish. *Sepals glandular-dotted. Stamens 6.* Achene *dull.*—Wet places.

12. **P. Virginia'num,** L. Calyx greenish, *unequally 4-parted.* Stamens 5. Styles 2, persistent on the flat achene. Flowers in

long and slender naked spikes. Stem upright, nearly smooth. Leaves ovate or ovate-lanceolate, taper-pointed, rough ciliate. Sheaths hairy and fringed.—Thickets, in rich soil.

+ + *Leaves heart-shaped or sagittate. Sheaths much longer on one side than on the other.*

13. **P. arifo'lium**, L., (HALBERD-LEAVED TEAR-THUMB) with grooved stem, halberd-shaped long-petioled leaves, flowers in short loose racemes, 6 stamens, and a flattish achene, is not uncommon on the Lower St. Lawrence; rare in Ontario.

14. **P. sagitta'tum**, L. (ARROW-LEAVED TEAR-THUMB.) *Stem 4-angled, the angles beset with reflexed minute prickles*, by which the plant is enabled to climb. Leaves arrow-shaped. Stamens 8. Achene 3-angled.—Common in low grounds, especially beaver-meadows.

15. **P. Convol'vulus**, L. (BLACK BINDWEED.) *Stem twining*, not prickly but *roughish; the joints naked.* Flowers in loose panicled racemes, 3 of the calyx-lobes ridged in fruit. Leaves heart-shaped and partly halberd-shaped. Not climbing so high as the next.—Cultivated grounds and waste places.

16. **P. dumeto'rum**, L., var. **scandens**, Gray. (CLIMBING FALSE BUCKWHEAT.) Stem twining high, *smooth; sheaths naked*, 3 of the calyx-lobes *winged in fruit.*—Moist thickets.

17. **P. cilino'de**, Michx. Stem twining, *minutely downy. Sheaths fringed at the base with reflexed bristles.*—Sandy pine woods and rocky hills.

2. RUMEX, L. DOCK. SORREL.

* *Herbage not sour, nor the leaves halberd-shaped.*

1. **R. orbicula'tus**, Gray. (GREAT WATER DOCK.) Growing in marshes. Stem erect, stout, 5–6 feet high. Leaves lanceolate, *not wavy-margined or heart-shaped*, often over a foot long. Flowers nodding *on thread-like pedicels.* Valves nearly orbicular, finely net-veined, each with a grain on the back.—Wet places.

2. **R. salicifo'lius**, Weinmann, (WHITE DOCK) may be looked for in marshes on the sea-coast and far northward. The whorls of flowers are dense and form a very conspicuous spike, owing to the great size of the grains on the back of the valves.

3. **R. verticilla'tus**, L. (Swamp Dock.) Leaves lanceolate or oblong-lanceolate, *not wavy*, the *lowest* often heart-shaped. Stem tall. Fruit-bearing pedicels slender, club-shaped, abruptly reflexed, several times longer than the fruiting calyx. Valves dilated-rhomboid, *strongly wrinkled*, each bearing a very large grain.—Swamps, common.

4. **R. crispus**, L. (Curled Dock.) *Leaves with strongly wavy or curly margins*, lanceolate. Whorls of flowers in long wand-like racemes. Valves grain-bearing.—Cultivated soil and waste places.

5. **R. obtusifo'lius**, L. (Bitter Dock.) Lowest leaves oblong heart-shaped, obtuse, only slightly wavy-margined; the upper oblong-lanceolate, acute. Whorls loose, *distant*. Valves somewhat halberd-shaped, *sharply toothed at the base*, usually *one only* grain-bearing.—Waste grounds.

** * Herbage sour; leaves halberd-shaped.*

6. **R. Acetosel'la**, L (Field or Sheep Sorrel.) Stem 6–12 inches high. *Flowers diœcious*, in a terminal naked panicle.—A very common weed in poor soil.

3. **FAGOPY'RUM**, Tourn. Buckwheat.

F. esculen'tum, Mœnch. (Buckwheat.) Old fields and copses, remaining after cultivation.

Order LXXV. LAURA'CEÆ. (Laurel Family.)

Trees or shrubs with spicy-aromatic bark and leaves, the latter simple (often lobed), alternate, and marked with small transparent dots (visible under a lens). Sepals 6, petal-like. Flowers diœcious or polygamo-diœcious. Stamens in sterile flowers 9, inserted at the base of the calyx. Anthers opening by uplifting valves. Ovary in fertile flowers free from the calyx, 1-celled, with a single ovule hanging from the top of the cell. Style and stigma 1. Fruit a 1-seeded drupe.

1. **SAS'SAFRAS**, Nees. Sassafras.

S. officina'le, Nees. A small or moderate-sized tree with yellowish or greenish-yellow twigs and ovate or 3-lobed entire leaves. Flowers greenish-yellow, in naked corymbs, appearing with the leaves in the axils of the latter. Drupe *blue*, on a reddish pedicel. The 9 stamens in 3 rows, the 3 inner each with a pair of yellow glands at the base of the filament. *Anthers 4-celled, 4-valved.*—Rich woods, in southern and western Ontario.

2. **LIN'DERA,** Thunberg. WILD ALLSPICE. FEVER-BUSH.

L. Benzo'in, Meisner. (SPICE-BUSH.) A nearly smooth shrub with oblong-obovate leaves, pale beneath. Flowers honey-yellow, in lateral umbel-like clusters, before the leaves. Stamens very much as in Sassafras, but the anthers are *2-celled and 2-valved.* Pistillate flowers with 15–18 rudiments of stamens. *Drupe red.* —Damp woods, in early spring.

ORDER LXXVI. THYMELEA'CEÆ. (MEZEREUM F.)

Shrubs with tough leather-like bark and entire leaves. Flowers perfect. Calyx tubular, resembling a corolla, pale yellow. Stamens twice as many as the lobes of the calyx (in our species 8). Style thread-like. Stigma capitate. Ovary 1-celled, 1-ovuled, free from the calyx. Fruit a berry-like drupe. Only one Species in Canada.

DIRCA, L. LEATHERWOOD. MOOSE-WOOD.

D. palustris, L. A branching shrub, 2–5 feet high, with curious *jointed branchlets* and nearly oval leaves on short petioles. Flowers in clusters of 3 or 4, preceding the leaves. Filaments exserted, half of them longer than the others.—Damp woods.

ORDER LXXVII. ELÆAGNA'CEÆ. (OLEASTER F.)

Shrubs with diœcious flowers, *and leaves which are scurfy on the under surface.* The calyx-tube in the fertile flowers *becomes fleshy and encloses the ovary, forming a berry-like fruit.* Otherwise the plants of this Order are not greatly different from those of the last.

SHEPHERD'IA, Nutt. SHEPHERDIA.

S. Canadensis, Nutt. Calyx in sterile flowers 4-parted. Stamens 8. Calyx in fertile flowers urn-shaped, 4-parted. Berries yellow. Branchlets brown-scurfy. Leaves opposite, entire, ovate, green above, silvery-scurfy beneath, the small flowers in their axils.—Gravelly banks of streams and lakes.

ORDER LXXVIII. SANTALA'CEÆ. (SANDALWOOD F.)

Low herbaceous or partly woody plants (with us) with perfect flowers, these *greenish-white*, in terminal or axillary corymbose clusters. Calyx bell-shaped or urn-shaped, 4-5-cleft, adherent to the 1-celled ovary, lined with a 5-lobed disk, the stamens on the edge of the latter between its lobes and *opposite the lobes of the calyx, to which the anthers are attached by a tuft of fine hairs.* Fruit nut-like, crowned with the persistent calyx-lobes.

COMAN'DRA, Nutt. BASTARD TOAD-FLAX.

C. umbella'ta, Nutt. Stem 8–10 inches high, leafy. Leaves oblong, pale green, an inch long. Flower-clusters at the summit of the stem. Calyx-tube prolonged and forming a neck to the fruit. Style slender.—Dry soil.

ORDER LXXIX. SAURURA'CEÆ. (LIZARD'S-TAIL F.)

A small family having, with us, but a single representative:—

SAURU'RUS, L. LIZARD'S-TAIL.

S. cer'nuus, L. A swamp herb, with jointed branching stem, 2 feet high. Leaves petioled, heart-shaped, with converging ribs. Flowers white, in a dense terminal spike, nodding at the end, each flower with a lanceolate bract. Flowers perfect, but entirely destitute of calyx and corolla. Stamens usually 6 or 7, with long slender white filaments. Carpels 3 or 4, slightly united at the base.

ORDER LXXX. CERATOPHYLLA'CEÆ. (HORNWORT F.)

Represented, with us, by a single species.

CERATOPHYL'LUM, L. HORNWORT.

C. demer'sum, L. An aquatic herb, with whorled finely dissected leaves, and minute axillary sessile monœcious flowers, without calyx or corolla, but with an 8–12-cleft involucre. Staminate flowers of 12–24 stamens with large sessile anthers. Pistillate flowers of a single 1-celled ovary, forming an achene, beaked with the slender style. *Embryo with 4 cotyledons.*—Under water in ponds and slow streams.

ORDER LXXXI. EUPHORBIA'CEÆ. (SPURGE F.)

Plants with milky juice and monœcious flowers, represented in Canada chiefly by the two following genera:

1. EUPHOR'BIA, L. SPURGE.

Flowers monœcious, the sterile and fertile ones both destitute of calyx and corolla, *but both contained in the same 4-5-lobed cup-shaped involucre which resembles a calyx*, and therefore the whole will probably at first sight be taken for a single flower. Sterile flowers numerous, *each of a single naked stamen from the axil of a minute bract.* Fertile flower only 1 in each involucre; ovary 3-lobed, *soon protruded on a long pedicel;* styles 3, each 2-cleft. Peduncles terminal, often umbellate.

* *Leaves all similar and opposite, short-petioled, green or blotched with brown above, furnished with scale-like or fringed stipules. Stems spreading or prostrate, much forked. Involucres in terminal or lateral clusters, or one involucre in each fork, the involucre invariably with 4 (mostly petal-like) glands in the sinuses.*

1. **E. polygonifo'lia**, L. Leaves *entire*, oblong-linear, mucronate, *very smooth.* Stipules bristly-fringed. Peduncles in the forks. *Glands of the involucre very small, not petal-like.* Pods obtusely angled. —Shores of the Great Lakes, in sandy or gravelly places.

2. **E. serpens**, H. B. K. Leaves *entire*, round-ovate, very small, smooth. Stipules membranaceous, triangular. Peduncles longer than the petioles, in loose clusters. Glands of the small involucre with minute crenulate appendages. Stems thread-like, prostrate. Pods acutely angled. *Seeds smooth.*—London and westward, not common.

3. **E. glyptosper'ma**, Engel. Leaves *serrulate* towards the apex, linear-oblong, *very unequal at the base.* Stipules lanceolate, cut into bristles. Peduncles as long as the petioles, in dense lateral clusters. Glands of the small involucre with crenulate appendages. Stems erect-spreading. Pods sharply angled. *Seeds sharply 4-angled, with 5 or 6 sharp transverse wrinkles.*—Gravelly soil.

4. **E. macula'ta,** L. Leaves *serrulate*, oblong-linear, *somewhat pubescent, with a brownish blotch in the centre*, very oblique at the base. *Peduncles in dense lateral clusters.* Glands of the involucre with reddish petal-like attachments. *Pods sharply angled.*—Roadsides.

5. **E. hypericifo'lia,** L. Stem ascending. Leaves *serrate*, often with a red spot or with red margins, oblique at the base, ovate-oblong or oblong-linear. *Peduncles in cymes at the ends of the branches.* Glands of the involucre with *white* or occasionally reddish petal-like attachments. Pod smooth, obtusely angled.—Cultivated soil.

** *Only the uppermost or floral leaves whorled or opposite. Stems erect. Stipules none. Involucres 5-lobed; inflorescence umbelliform, in the forks of the branches, and terminal.*

6. **E. corolla'ta,** L. Conspicuous for the *5 bright-white false lobes of the involucre*, resembling petals; the true lobes very small.—Gravelly or sandy soil.

*** *Involucres chiefly in terminal umbels, and their glands always without petal-like attachments. Leaves without stipules or blotches, those of the stem alternate or scattered, the floral ones usually of a different shape, and whorled or opposite.*

7. **E. platyphyl'la,** L. Umbel 5-rayed. Stem erect, 8-18 inches high. Upper stem-leaves lance-oblong, acute, serrulate, the uppermost heart-shaped, the floral ones triangular-ovate and cordate. *Pod warty*—Shores of the Great Lakes.

8. **E. Heliosco'pia,** L. Umbel first 5-rayed, then with 3, and finally merely forked. Stem ascending, 6-12 inches high. Leaves all obovate, rounded or notched at the apex, serrate. *Pods smooth.*—Along the Great Lakes.

9. **E. Cyparis'sias,** L., with densely clustered stems, and crowded linear stem-leaves (the floral ones round heart-shaped), and a many-rayed umbel, has escaped from gardens in some localities.

2. ACALY'PHA, L. Three-seeded Mercury.

A. Virgin'ica, L. Flowers monœcious, both kinds having a calyx, the staminate 4-parted, the pistillate 3–5-parted; no involucre. Staminate flowers very small, in spikes, with 1–3 pistillate flowers at the base, in the axil of a large leaf-like 5–9-lobed bract. Stamens 8–16, monadelphous at the base, the anther-cells hanging from the apex of the filament. Styles 3, the stigmas cut-fringed, usually red. Pod separating into 3 globular carpels. A nettle-like weed, with ovate, sparsely serrate, alternate, long-petioled leaves.—Fields and open places.

ORDER LXXXII. URTICA'CEÆ. (NETTLE F.)

Herbs, shrubs, or trees, with monœcious or diœcious (or, in the Elms, sometimes perfect) flowers, with a regular calyx free from the 1–2-celled ovary which becomes a 1-seeded fruit. Stamens opposite the lobes of the calyx. This Order is divided into four well-marked Suborders.

SUBORDER I. ULMA'CEÆ. (ELM FAMILY.)

Trees, with alternate simple leaves, and deciduous small stipules. Flowers often perfect. Styles 2. *Fruit a samara winged all round, or a drupe.*

**Fruit a samara ; anthers extrorse.*

1. **Ulmus.** Flowers in lateral clusters, earlier than the leaves, purplish or greenish-yellow. Calyx bell-shaped, 4–9-cleft. Stamens 4–9 ; the filaments long and slender. Ovary 2-celled, but the samara only 1-seeded. Stigmas 2.

* **Fruit a drupe ; anthers introrse.*

2. **Celtis.** Flowers greenish, polygamous, the pistillate solitary or in pairs, appearing with the leaves. Calyx 5–6-parted, persistent. Stamens 5–6. Stigmas 2, long and pointed and recurved. Ovary 1-ovuled.

SUBORDER II. ARTOCAR'PEÆ. (BREAD-FRUIT & FIG F.)

Flowers monœcious or diœcious, crowded in catkin-like spikes or heads, the whole pistillate catkin becoming an aggregate fruit from the enlargement of the calyx in the several flowers. Calyx 4-parted. Stamens 4. Ovary 2-celled, 1 cell eventually disappearing. Styles 2.

3. **Morus.** Pistillate and staminate flowers in separate catkins. Trees with milky juice and rounded leaves. Staminate spikes slender.

SUBORDER III. URTI'CEÆ. (NETTLE FAMILY.)

Herbs with watery juice and opposite or alternate leaves, often beset with stinging hairs. Flowers monœcious or diœcious, in spikes or racemes. Stamens as many as the sepals. Style only 1. Ovary 1-celled. Fruit an achene.

4. **Urti'ca.** *Leaves opposite.* Plant beset with stinging hairs. Sepals 4 in both sterile and fertile flowers. Stamens 4. Stigma a small sessile tuft. Achene flat, enclosed between the 2 larger sepals. Flowers greenish.

5. **Laport'ea.** *Leaves alternate.* Plant beset with stinging hairs. Sepals 5 in the sterile flowers, 4 in the fertile, 2 of them much smaller than the other 2. Stigma awl-shaped. Achene flat, *very oblique, reflexed on its winged pedicel.*

6. **Pil'ea.** Leaves opposite. *Whole plant very smooth and semi-transparent.* Sepals and stamens 3–4. Stigma a sessile tuft.

7. **Bœhme'ria.** Leaves mostly opposite. No stinging hairs. Sepals and stamens 4 in the sterile flowers. Calyx tubular or urn-shaped in the fertile ones, and enclosing the achene. Stigma long and thread-like.

8. **Parieta'ria.** Leaves alternate, entire, 3-ribbed. No stinging hairs. Flowers polygamous, in involucrate-bracted cymose axillary clusters. Calyx of the pistillate flowers tubular or bell-shaped, 4-lobed. Stigma tufted. Staminate flowers nearly as in the last.

SUBORDER IV. CANNABIN'EÆ. (HEMP FAMILY.)

Rough herbs with watery juice and tough bark. Leaves opposite and *palmately compound.* Flowers diœcious. Sterile ones in compound racemes; stamens 5; sepals 5. Fertile ones in crowded clusters; sepal only 1, embracing the achene. Stigmas 2.

9. **Can'nabis.** A rather tall rough plant with palmately compound leaves of 5–7 linear-lanceolate serrate leaflets.

1. ULMUS, L. ELM.

1. **U. fulva,** Michx. (RED OR SLIPPERY ELM.) Flowers nearly sessile. *Leaves very rough above, taper-pointed. Buds downy with rusty hairs.* A medium-sized tree, with mucilaginous inner bark.

2. **U. America'na,** L. (AMERICAN OR WHITE ELM.) *Leaves not rough above, abruptly pointed.* Flowers on drooping pedicels. *Buds glabrous.* A large ornamental tree, with drooping branchlets.—Moist woods.

3. **U. racemo'sa,** Thomas. (CORKY WHITE ELM.) Resembling the last, but the *bud-scales are downy-ciliate, the branches corky, and the flowers racemed.*—Chiefly along roadsides and borders of fields.

2. **CEL'TIS**, L. NETTLE-TREE. HACKBERRY.

C. occidenta'lis, L. (SUGARBERRY.) A small tree of Elm-like aspect. *Leaves reticulated*, ovate, taper-pointed, serrate, more or less oblique at the base. Fruit as large as a pea, dark-purple when ripe, the flesh thin.—Low grounds; a few trees here and there through Ontario.

3. **MORUS**, Tourn. MULBERRY.

M. rubra, L. (RED MULBERRY.) Leaves heart-ovate, rough above, downy beneath, pointed. Fruit red, turning dark-purple, long.—Niagara district, and south-westward.

4. **URTI'CA**, Tourn. NETTLE.

U. gra'cilis, Ait. Stem slender, 2–6 feet high. Leaves ovate-lanceolate, pointed, serrate, 3–5-nerved from the base, nearly smooth, the long petioles with a few bristles. Flower-clusters in slender spikes.—Moist ground and along fences.

5. **LAPORT'EA**, Gaudichaud. WOOD-NETTLE.

L. Canadensis, Gaudichaud. Stem 2–3 feet high. Leaves large, ovate, long-petioled, *a single 2-cleft stipule in the axil.*—Moist woods.

6. **PIL'EA**, Lindl. RICHWEED. CLEARWEED.

P. pu'mila, Gray. Stem 3–18 inches high. Leaves ovate, coarsely toothed, 3-ribbed.—Cool moist places.

7. **BŒHME'RIA**, Jacq. FALSE NETTLE.

B. cylin'drica, Willd. Stem 1–3 feet high, smoothish. Leaves ovate-oblong or ovate-lanceolate, serrate, 3-nerved, long-petioled. Stipules separate.—Moist shady places.

8. **PARIETA'RIA**, Tourn. PELLITORY.

P. Pennsylvan'ica, Muhl. A low annual, simple or sparingly branched, minutely downy. Leaves oblong-lanceolate, thin, veiny, roughish with opaque dots.—Usually in crevices of limestone rocks; not very common.

9. **CAN'NABIS**, Tourn. HEMP.

C. sati'va, L. (HEMP.) Common everywhere along roadsides and in waste places.

ORDER LXXXIII. PLATANA'CEÆ. (PLANE-TREE F.)

Represented only by the Genus

PLAT'ANUS, L. PLANE-TREE. BUTTONWOOD.

P. occidenta'lis, L. (AMERICAN PLANE-TREE or SYCAMORE.) A fine large tree found in south-western Ontario. Leaves alternate, rather scurfy when young, palmately lobed or angled, the lobes sharp-pointed; *stipules sheathing.* Flowers monœcious, both sterile and fertile ones in catkin-like heads, without calyx or corolla, but with small scales intermixed. Ovaries in the fertile flowers club-shaped, tipped with the thread-like simple style, and downy at the base. Fertile heads solitary, on slender peduncles. The white bark separates into thin plates.

ORDER LXXXIV. JUGLANDA'CEÆ. (WALNUT F.)

Trees with alternate pinnate leaves and no stipules. Flowers monœcious. Sterile flowers in catkins. Fertile flowers solitary or in small clusters, with a regular 3–4-lobed calyx adherent to the ovary. Fruit a sort of drupe, the fleshy outer layer at length becoming dry and forming a husk, the inner layer hard and bony and forming the nut-shell. Seed solitary in the fruit, very large and 4-lobed. This Order comprises the Walnuts, Butternuts, and Hickories.

Synopsis of the Genera.

1. **Jug'lans.** Sterile flowers in *solitary* catkins from the previous year's wood. Filaments of the numerous stamens very short. Fertile flowers on peduncles at the ends of the branches. Calyx 4-toothed, *with small petals at the sinuses.* Styles and stigmas 2, the latter fringed. *Exocarp or husk drying without splitting. Shell of the nut very rough and irregularly furrowed.*

2. **Car'ya.** Sterile flowers in slender *clustered* catkins. Stamens 3–10, with very short filaments. Fertile flowers in small clusters at the ends of the branches. Calyx 4-toothed; *no petals.* Stigmas 2 or 4, large. *Exocarp 4-valved, drying and splitting away from the very smooth and bony nut-shell.*

1. JUG'LANS, L. WALNUT.

1. **J. ciner'ea**, L. (BUTTERNUT.) Leaflets oblong-lanceolate, pointed, serrate. *Petioles and branchlets clammy. Fruit oblong, clammy.*—Rich woods,

2. **J. nigra**, L. (BLACK WALNUT.) Leaflets ovate-lanceolate, taper-pointed, serrate. Petioles downy *but not clammy*. Fruit spherical. Wood a darker brown than in the Butternut.—Rich woods; rare northward.

2. CAR'YA, Nutt. HICKORY.

1. **C. alba**, Nutt. (SHELL-BARK HICKORY.) *Leaflets 5*, the lower pair much smaller than the others. Husk of the fruit splitting *completely* into 4 valves. Nut flattish-globular, mucronate. Bark of the trunk rough, scaling off in rough strips.—Rich woods.

2. **C. tomento'sa**, Nutt. (WHITE-HEART HICKORY.) Sparingly found in the Niagara district and south-westward. Leaflets 7–9. Bark close but not shaggy, and not scaling off on the old trunks. Husk as in the last. Catkins, shoots, and lower surface of the leaves *tomentose* when young. Nut *globular*.

3. **C. ama'ra**, Nutt. (SWAMP HICKORY or BITTERNUT.) *Leaflets 7–11*. Husk of the fruit splitting *half way* down. Nut *spherical*, short-pointed. Bark smooth, not scaling off.—Moist ground.

4. **C. porci'na**, Nutt. (PIG-NUT. BROOM-HICKORY.) Leaflets 5–7. Shoots, etc., *glabrous*. Husk as in the last. Nut *oblong or oval*.—Niagara district, and south-westward.

ORDER LXXXV. CUPULIF'ERÆ. (OAK FAMILY.)

Shrubs or trees, with alternate simple leaves, deciduous stipules, and monœcious flowers. Sterile flowers in catkins (but in Beech in small heads); the fertile ones solitary or clustered, and furnished with an involucre which forms a scaly cup or a bur surrounding the nut.

Synopsis of the Genera.

1. **Quercus.** Sterile flowers *with a calyx* including few or several stamens with slender filaments. Fertile flowers scattered or somewhat clustered, each in a scaly involucre or cupule. Nut (acorn) rounded, the base enclosed by the cupule. (Part I, sec. 71.)

2. **Casta'nea.** Sterile flowers in long slender catkins. *Calyx 6-parted.* Fertile flowers usually 3 in each involucre, the latter prickly, forming a bur. Calyx 6-lobed. Stigmas bristle-shaped. Nuts enclosed (mostly 2 or 3

together) in the prickly 4-valved involucre, flattened when there are more than one.

3. **Fagus.** Sterile flowers in a small head on drooping peduncles. *Calyx bell-shaped.* Fertile flowers in pairs in the involucre, which consists of awl-shaped bractlets grown together at the bases. Calyx-lobes awl-shaped. *Nuts 3-angled, generally in pairs in the bur-like 4-valved cupule.* Bark close, smooth, and light gray.

4. **Cor'ylus.** Sterile flowers in drooping catkins. *No calyx.* Stamens 8 (with 1-celled anthers), *and 2 small bractlets* under each bract. Fertile flowers in a small scaly head; one ovary, surmounted by 2 long red stigmas, under each scale, and accompanied by a pair of bractlets which, in fruit, enlarge and form a *leaf-like or tubular fringed or toothed involucre closely enveloping each nut.* Sterile catkins from the axils of the previous year. Fertile flowers terminating the new shoots.

5. **Os'trya.** Sterile flowers in drooping catkins. *Calyx wanting.* Stamens several under each bract, *but not accompanied by bractlets.* Fertile flowers in short catkins, 2 under each bract, each ovary tipped with 2 long stigmas, and *surrounded by a tubular bractlet which, in fruit, becomes a greenish-white inflated bag, having the small nut in the bottom.*

6. **Carpi'nus.** Sterile flowers in drooping catkins. *Calyx wanting.* Stamens several under each bract; *no bractlets.* Fertile flowers much as in Ostyra, *but the bractlets surrounding the ovaries are not tubular but open, and in fruit become leaf-like, one on each side of the small nut.*

1. QUERCUS, L. Oak.

* *Acorns ripening the first year, and therefore borne on the new shoots. Lobes or teeth of the leaves not bristle-pointed.*

1. **Q. alba,** L. (White Oak.) A large tree. Leaves (when mature) smooth, bright green above, whitish beneath, obliquely cut into few or several oblong entire *lobes.* The oblong nut much larger than the saucer-shaped rough cupule.—Rich woods.

2. **Q. macrocar'pa,** Michx. (Bur Oak. Mossy-cup White Oak.) A medium-sized tree. Leaves *deeply lobed,* smooth above, pale or downy beneath. Acorn broadly ovoid, *half or altogether covered by the deep cup, the upper scales of which taper into bristly points making a fringed border.* Cup varying greatly in size, often very large.—Rich soil.

3. **Q. bi'color,** Willd. (Swamp White Oak.) A tall tree. Leaves *sinuate-toothed,* but hardly lobed, *wedge-shaped at the base, downy or hoary* beneath, the main veins 6–8 pairs. Cup nearly hemispherical, about half as long as the oblong-ovoid acorn, some-

times with a fringed border. *Peduncle in fruit longer than the petiole.*—Low grounds.

4. **Q. Pri'nus,** L. (CHESTNUT OAK.) A small tree. Leaves minutely downy beneath, *the main veins 10–16 pairs*, sinuate-toothed, acute or obtuse at the base. *Peduncle shorter than the petiole.* Cup hemispherical; acorn as in the last.—Lake Erie coast.

Var. **hu'milis,** Marsh, (*Q. prinoides*, Willd., in Macoun's Catalogue) is much more abundant with us than the species itself. It has the characters of the species, but is a shrub, 2–4 feet high. Fruit sessile or nearly so.

* * *Acorns ripening the second year, and therefore borne on the previous year's wood, below the leaves of the season. Lobes or teeth of the leaves bristle-pointed.*

5. **Q. coccin'ea,** Wang. (SCARLET OAK.) A large tree. Leaves bright green, shining above, turning red in autumn, rounded at the base, deeply pinnatifid, the lobes divergent and sparingly cut-toothed. Bark gray outside, *reddish* inside. *Cup top-shaped or hemispherical with a more or less conical base*, covering half or more of the rather small acorn.

Var. **tincto'ria,** Gray. (*Q. tinctoria*, Bartram, in Macoun's Catalogue.) (QUERCITRON, YELLOW-BARKED, or BLACK OAK.) Leaves usually less deeply pinnatifid, slender-petioled, rather rounded at the base, rusty-downy when young, smooth and shining above when mature, often slightly pubescent beneath, turning brownish, orange, or dull red in autumn. Cup as in the species, but the bark darker and rougher and *yellow or orange* inside.—Western Ontario; mostly in dry soil, but occasionally in moist places.

6. **Q. rubra,** L. (RED OAK.) A large tree. Leaves moderately pinnatifid, turning dark-red in the autumn. *Cup saucer-shaped*, sessile or nearly so, very much shorter than the oblong-ovoid acorn.—Rich and poor soil.

7. **Q. palustris,** Du Roi. (PIN OAK.) A medium-sized tree. Cup flat-saucer-shaped, very much shorter than the *ovoid-globose* acorn, which is about half an inch long. Leaves deeply pinnatifid, with divergent lobes and rounded sinuses.—Niagara district and south-westward.

2. **CASTA'NEA**, Tourn. CHESTNUT.

C. vesca, L., var. **America'na**, Michx. (*C. vulgaris*, var. *Americana*, A. DC., in Macoun's Catalogue.) (CHESTNUT.) A large tree. Leaves oblong-lanceolate, pointed coarsely and sharply serrate, acute at the base. Nuts 2 or 3 in each bur. —South-western Ontario.

3. **FAGUS**, Tourn. BEECH.

F. ferrugin'ea, Ait. (AMERICAN BEECH.) A very common tree in rich woods, the branches horizontal. Leaves oblong-ovate, taper-pointed, toothed, the very straight veins terminating in the teeth.

4. **COR'YLUS**, Tourn. HAZEL-NUT. FILBERT.

1. **C. America'na**, Walt. (WILD HAZEL-NUT.) Leaves roundish heart-shaped. *Involucre spreading out above, leaf-like and cut-toothed.*—Chiefly in south-western Ontario; in thickets.

2. **C. rostra'ta**, Ait. (BEAKED HAZEL-NUT.) A rather common shrub, easily distinguished from No. 1 by the involucre, *which is prolonged into a narrow tube much beyond the nut, and is densely bristly-hairy.*

5. **OS'TRYA**, Micheli. HOP-HORNBEAM. IRON-WOOD.

O. Virgin'ica, Willd. (IRON-WOOD.) A slender tree with brownish furrowed bark. Leaves oblong-ovate, taper-pointed, sharply doubly serrate. Fertile catkin like a hop in appearance. Wood very hard and close.—Rich woods.

6. **CARPI'NUS**, L. HORNBEAM.

C. America'na, Michx. (BLUE or WATER BEECH.) Small trees with *furrowed trunks* and close smooth gray bark. Leaves ovate-oblong, pointed, doubly serrate.—Along streams. Resembling a Beech in general aspect, but with inflorescence like that of Iron-wood.

ORDER LXXXVI. MYRICA'CEÆ. (SWEET-GALE F.)

Shrubs with monœcious or diœcious flowers, both sterile and fertile ones collected in short catkins or heads. *Leaves with resinous dots, usually fragrant.* Fruit a 1-seeded dry drupe or little nut, usually coated with waxy grains.

Synopsis of the Genera.

1. **Myri'ca.** Flowers chiefly diœcious, catkins lateral, each bract with a pair of bractlets underneath. Stamens in the sterile flowers 2–8. Ovary solitary in the fertile flowers, 1-celled, tipped with 2 thread-like stigmas, and surrounded by 2–4 small scales at the base. In our species the 2 scales form wings at the base of the nut.—A shrub, 3–5 feet high.

2. **Compto'nia.** A low shrub, a foot or more in height, with fern-like very sweet-scented leaves. Flowers monœcious. Sterile catkins cylindrical. Fertile ones spherical, the ovary surrounded by 8 awl-shaped persistent scales, so that the catkin resembles a bur.

1. MYRI'CA, L. BAYBERRY. WAX-MYRTLE.

M. Ga'le, L. (SWEET GALE.) Leaves wedge-lanceolate, serrate towards the apex, pale. The small nuts in crowded heads, and winged by the 2 scales.—Bogs.

2. COMPTO'NIA, Solander. SWEET-FERN.

C. asplenifo'lia, Ait. (*Myrica asplenifolia*, Endl., in Macoun's Catalogue.) Leaves linear-lanceolate in outline, deeply pinnatifid, the lobes numerous and rounded.—Dry soil; especially in Pine barrens.

ORDER LXXXVII. BETULA'CEÆ. (BIRCH FAMILY.)

Trees or shrubs with monœcious flowers, both sorts in catkins, 2 or 3 flowers under each scale or bract of the catkin. Ovary 2-celled and 2-ovuled, but in fruit only 1-celled and 1-seeded. Fruit a small nut. Stigmas 2, long and slender. Twigs and leaves often aromatic.

Synopsis of the Genera.

1. **Bet'ula.** Sterile catkins long and pendulous, formed during summer and expanding the following spring; each flower consisting of one small scale to which is attached 4 short filaments; 3 flowers under each scale of the catkin. Fertile catkins stout, oblong, the scales or bracts 3-lobed and with 2 or 3 flowers under each; each flower a naked ovary, becoming a winged nutlet in fruit. Bark easily coming off in sheets.

2. **Alnus.** Catkins much as in Betula, but each fertile and sterile flower has a distinct 3–5-parted calyx. Catkins solitary or clustered at the ends of leafless branchlets or peduncles. Nutlets wingless or nearly so.

(These two genera are included in Cupuliferæ in Macoun's Catalogue.)

1. BET'ULA, Tourn. Birch.

1. **B. lenta,** L. (Cherry-Birch. Sweet or Black Birch.) Bark of the trunk dark brown, close, aromatic; that of the twigs bronze-coloured. Wood rose-coloured. Leaves ovate, with somewhat heart-shaped base, doubly serrate, pointed, short-petioled. Fruiting catkins sessile, thick, oblong-cylindrical.—Moist woods.

2. **B. lu'tea,** Michx. (Yellow or Gray Birch.) Bark of the trunk yellowish-gray, somewhat silvery, scaling off in thin layers. Leaves hardly at all heart-shaped. Fruiting catkins thicker and shorter than in No. 1.—Moist woods.

3. **B. papyra'cea,** Ait. (*B. papyrifera*, Michx., in Macoun's Catalogue.) (Paper or Canoe Birch.) Bark of the trunk white, easily separating in sheets. Leaves ovate, taper-pointed, heart-shaped, long-petioled. Fruiting catkins cylindrical, usually hanging on slender peduncles.—Woods.

4. **B. pu'mila,** L. (Low Birch.) A *shrub* with brownish bark, *not glandular*. Leaves obovate or roundish, *pale beneath;* veinlets on both surfaces finely reticulated. Catkins mostly erect, on short peduncles.—Bogs and low grounds, northward.

2. ALNUS, Tourn. Alder.

1. **A. inca'na,** Willd. (Speckled or Hoary Alder.) A shrub or small tree, growing in thickets in low grounds along streams. Leaves oval or ovate, rounded at the base, serrate, whitish beneath. Flowers preceding the leaves in early spring, from clustered catkins formed the previous summer and remaining naked over winter. *Fruit wingless.*

2. **A. vir'idis,** DC. (Green or Mountain Alder.) A shrub 3–8 feet high, along mountain streams. Flowers appearing with the leaves, the *staminate* catkins having remained naked during the winter, *the pistillate enclosed in a scaly bud. Fruit with a thin wing.*—Northward.

Order LXXXVIII. SALICA'CEÆ. (Willow Family.)

Trees or shrubs with diœcious flowers, both sorts in catkins, one under each scale of the catkin. No calyx. Fruit 1-celled, *many-seeded*, the seeds furnished with tufts of down. (See Part

I., section 74, for description of typical flowers.) This Order comprises the Willows and Poplars.

Synopsis of the Genera.

1. **Salix.** Trees with mostly *long and pointed leaves* and slender branches. Bracts or scales of the catkins *not toothed.* Stamens mostly 2 under each bract, but in one or two species as many as 5 or 6. Stigmas short. Catkins appearing before or with the leaves.

2. **Pop'ulus.** Trees with *broad* and more or less heart-shaped leaves. Bracts of the catkins *toothed or cut at the apex.* Stamens 8–30, or even more, under each scale. Stigmas long. Catkins long and drooping, preceding the leaves.

1. SALIX, Tourn. WILLOW.

* *Catkins lateral and sessile, appearing before the leaves. Scales dark red or brown, persistent. Usually no leaf-like bracts at the base of the catkins. Stamens 2.*

+ *Leaves veiny, hairy or woolly, and with somewhat revolute margins.*

1. **S. can'dida,** Willd. (HOARY WILLOW.) A shrub not more than 3 or 4 feet high, growing in bogs and wet places; the twigs and leaves clothed with a web-like wool, giving the whole plant a whitish aspect. Leaves lanceolate, narrow. Stipules small, lanceolate, toothed. Catkins cylindrical.

2. **S. hu'milis,** Marshall. (PRAIRIE WILLOW.) A shrub 3–8 feet high, growing usually in dry or barren places. Leaves lanceolate, not so taper-pointed as in No. 1, slightly downy above, thickly so beneath. Stipules semi-ovate or moon-shaped, with a few teeth, shorter than the petioles. Catkins ovoid.

+ + *Leaves smooth and shining above, not woolly beneath. Catkins large, clothed with long glossy hairs.*

3. **S. dis'color,** Muhl. (GLAUCOUS WILLOW.) A shrub or small tree, 8–15 feet high, growing in low grounds and along streams. Leaves lanceolate or ovate-lanceolate, irregularly toothed *in the middle of the margin*, entire at each end, white-glaucous beneath. Stipules moon-shaped, toothed.

The 3 species just described frequently have compact heads of leaves, resembling cones, at the ends of the branches. This is probably a diseased condition due to puncturing by insects.

4. **S. petiola'ris,** Smith. (PETIOLED WILLOW.) A shrub on sandy river-banks. Leaves lanceolate, finely and evenly serrate,

silky-gray or glaucous beneath, smooth above. Catkins with a few small leaf-like bracts at the base. Scales of the fertile catkins acute, very hairy. Ovary tapering, silky, stalked. Sandy river-banks.

* * *Catkins lateral, with 4 or 5 leafy bracts at the base, preceding (or sometimes accompanying) the leaves. Scales dark red or brown, persistent. Stamens 2.*

5. **S. corda'ta,** Muhl. (HEART-LEAVED WILLOW.) A shrub or small tree, growing in wet grounds. Leaves lanceolate, not always heart-shaped, sharply serrate, smooth. Catkins cylindrical, *leafy-bracted at the base.* Var. **angusta'ta** has long narrow leaves.

* * * *Catkins lateral, appearing along with the leaves, leafy-bracted at the base. Stamens 2. Scales persistent.*

6. **S. liv'ida,** Wahl. Var. **occidenta'lis,** Gray. (*S. rostra'ta*, Rich., in Macoun's Catalogue.) (LIVID WILLOW.) A good-sized shrub, chiefly in moist situations. *Leaves oblong* or obovate-lanceolate, barely toothed, downy above, very veiny, hairy and glaucous beneath. Stipules semi-lunar, toothed. Ovary at length raised on a very slender stalk.

* * * * *Catkins long and loose, peduncled, not lateral, but borne on the ends of the new shoots. Scales greenish-yellow, deciduous. Filaments hairy below.*

+ *Stamens 3–6 or more.*

7. **S. lu'cida,** Muhl. (SHINING WILLOW.) A shrub or small bushy tree, growing along streams. *Leaves ovate-oblong or narrower*, with a long tapering point, *shining on both sides*, serrate. Stamens mostly 5.

8. **S. nigra,** Marshal. (BLACK WILLOW.) A larger tree than No. 6, with a roughish black bark, growing along streams. *Leaves narrowly lanceolate*, tapering at each end, serrate, smooth, green on both sides. Stamens 3–6.

+ + *Stamens 2.*

9. **S. longifo'lia,** Muhl. (LONG-LEAVED WILLOW.) A shrub or small tree, varying greatly in size, growing along streams in sandy or gravelly places. Leaves linear-lanceolate, very long, tapering towards both ends, nearly sessile, serrate with a few spreading teeth, grayish-hairy when young.

2. POP'ULUS, Tourn. POPLAR.

1. **P. tremuloi'des**, Michx. (AMERICAN ASPEN.) A tree with greenish-white bark, and *roundish heart-shaped leaves*, continually in a state of agitation, due to the lateral compression of the petiole, and the consequent susceptibility of the leaf to the least motion of the air. *Teeth of the leaves small.*

2. **P. grandidenta'ta**, Michx., (LARGE-TOOTHED ASPEN) has *roundish ovate leaves with large irregular sinuate teeth.*

3. **P. balsamif'era**, L. (BALSAM POPLAR.) A tall tree, growing in swamps and along streams; *the large buds varnished with resinous matter.* Leaves *ovate*, tapering, finely serrate, whitish beneath. Stamens very numerous.

4. **P. monilif'era**, Ait. (COTTONWOOD.) A tree with broad deltoid leaves, slightly heart-shaped, serrate with incurved teeth. Young branches *slightly angled*, at length round. Fertile catkins very long, the scales *cut-fringed*, *not hairy*. Along the main line of the Grand Trunk Railway.

Var. **can'dicans**, Gray, (BALM OF GILEAD) has broader and *more or less heart-shaped* leaves.

SUBCLASS II. GYM'NOSPERMS.

Ovules and seeds naked (not enclosed in a pericarp), and fertilized by the direct application of the pollen. Represented in Canada by a single Order.

ORDER LXXXIX. CONIF'ERÆ. (PINE FAMILY.)

Trees or shrubs with resinous juice and mostly monœcious flowers, these in catkins except in the last genus (Taxus), in which the fertile flower is solitary and the fruit berry-like. Leaves awl-shaped or needle-shaped. (See Part I., Cap. xvi., for descriptions of typical plants.)—The Order comprises three well-marked Suborders.

SUBORDER I. ABIETIN'EÆ. (PINE FAMILY PROPER.)

Fruit a true *cone*, the imbricated scales *in the axils of bracts.* Ovules 2 on the inside of each scale at the base, in fruit coming off with a wing attached to each. (Part I., Figs. 197, 198.)

* *Cones not ripening till the second year.*

1. **Pinus.** Leaves needle-shaped, *2–5 in a cluster*, *evergreen*, in the axil of a thin scale. Sterile catkins in spikes at the bases of the new shoots, consisting of many almost sessile anthers spirally inserted on the axis. Cones more or less woody, the scales widely spreading when ripe. Cotyledons of the embryo several.

* * *Cones ripening the first year.*

2. **A'bies.** Leaves linear or needle-shaped, *scattered uniformly along the new shoots, evergreen.* Sterile catkins in the axils of last year's leaves. Cones with thin scales.
3. **Larix.** Leaves needle-shaped, *clustered or fascicled on lateral spurs of last year's wood, many in each bundle, falling off in the autumn*; those on the new shoots scattered, but *deciduous like the rest.*

SUBORDER II. CUPRESSIN'EÆ. (CYPRESS F.)

Fertile flowers of only a few scales, these *not in the axils of bracts*, forming in fruit either a very small loose and dry cone, or a sort of false berry owing to the thickening of the scales.

* *Flowers monœcious. Fruit a small loose cone.*

4. **Thuja.** Leaves some *awl-shaped*, others *scale-like*, closely imbricated on the *flat branches.* Catkins ovoid, terminal.

* * *Flowers mostly diœcious. Fruit berry-like, black with a bloom.*

5. **Junip'erus.** Leaves awl-shaped or scale-like, sometimes of both shapes, evergreen, prickly-pointed, glaucous-white on the upper surface, and in whorls of 3, or opposite.

SUBORDER III. TAXIN'EÆ. (YEW FAMILY.)

Fertile flower solitary, consisting of a naked ovule surrounded by a disk which becomes pulpy and berry-like in fruit, enclosing the nut-like seed. *Berry red.*

6. **Taxus.** Flowers chiefly diœcious. Leaves evergreen, *mucronate*, rigid, scattered.—A low straggling bush, usually in the shade o other evergreens.

1. PINUS, Tourn. PINE.

1. **P. resino'sa**, Ait. (RED PINE.) *Leaves in twos*, slender. Bark rather smooth, *reddish.*—Common northward.

2. **P. stro'bus,** L. (WHITE PINE.) *Leaves in fives*, slender. Bark smooth except on old trees, not reddish.—Common.

2. **A'BIES**, Tourn. SPRUCE. FIR.

1. **A. nigra,** Poir. (*Picea nigra*, Link, in Macoun's Catalogue.) (BLACK SPRUCE.) *Leaves needle-shaped and 4-sided, pointing in all directions.* Cones hanging, *persistent*, scales with thin edges.—Swamps and cold woods.

2. **A. alba,** Michx. (*Picea alba*, Link, in Macoun's Catalogue.) (WHITE SPRUCE.) Leaves as in No. 1. Cones hanging, *deciduous*, the scales with thickish edges.—Swamps and cold woods.

3. **A. Canadensis,** Michx. (*Tsuga Canadensis*, Carr, in Macoun's Catalogue.) (HEMLOCK SPRUCE.) *Leaves flat*, lighter beneath, *pointing only in two directions, i.e.*, right and left on each side of the branch, obtuse. Cones hanging, persistent.—Hilly or rocky woods.

4. **A. balsa'mea,** Marshall. (BALSAM FIR.) *Leaves flat*, the lower surface whitish and the midrib prominent, crowded, pointing mostly right and left on the branches. *Cones erect* on the upper sides of the branches, violet-coloured, *the scales slender-pointed.*—Damp woods and swamps.

3. **LARIX**, Tourn. LARCH.

L. America'na, Michx. (AMERICAN LARCH. TAMARAC.) A slender and very graceful tree with soft leaves in fascicles, falling off in autumn.—Swamps.

4. **THUJA**, Tourn. ARBOR VITÆ.

T. occidenta'lis, L. (AMERICAN ARBOR VITÆ.) The well-known cedar of cedar-swamps.—Common.

5. **JUNIP'ERUS**, L. JUNIPER.

1. **J. commu'nis,** L. (COMMON JUNIPER.) A spreading shrub with ascending stems, growing on dry hill-sides. *Leaves in whorls of 3*, whitish above, prickly-pointed.

2. **J. Virgini'ana,** L. (RED CEDAR.) A shrub or small tree with *mostly opposite leaves* of two forms, viz.: awl-shaped and loose, and scale-shaped and appressed. Fruit small, erect. Wood reddish and odorous.—Dry sterile soil.

6. **TAXUS**, Tourn. Yew.

T. bacca'ta, L., var. **Canadensis,** Gray. (American Yew. Ground Hemlock.) A low straggling shrub. Leaves green on both sides. *Berry globular, red.*

CLASS II. MONOCOTYLE'DONS.

For characters of the Class see Part I., chap. xv.

I. SPADIC'EOUS DIVISION.

Flowers aggregated on a *spadix* (Part I., sec. 94), with or without a *spathe* or sheathing bract.

ORDER XC. ARA'CEÆ. (ARUM FAMILY.)

Herbs with pungent juice and simple or compound leaves, *these sometimes net-veined* and hence suggesting that the plants may be Dicotyledons. Spadix usually accompanied by a spathe. Flowers either without a perianth of any kind, or with 4–6 sepals. Fruit usually a berry.

Synopsis of the Genera.

* *Leaves not linear. Flowers without perianth of any sort. Spadix accompanied by a spathe.*

1. **Arisæ'ma.** Flowers mostly diœcious, collected on the lower part of the spadix only. Spathe (in our common species) arched over the spadix. Scape from a solid bulb. Leaves compound, net-veined, sheathing the scape below with their petioles. Berries bright red.
2. **Calla.** Flowers (at least the lower ones) *perfect*, covering the whole spadix. Spathe open and spreading, with a white upper surface, tipped with an abrupt point. Scape from a creeeping rootstock. Leaves not net-veined, simple, heart-shaped.

* * *Leaves not linear. Flowers with a perianth of 4 sepals. Spadix surrounded by a spathe.*

3. **Symplocar'pus.** Leaves all radical, very large and veiny, appearing after the spathes, which are close to the ground and are produced very early in spring. Flowers perfect, their ovaries immersed in the spadix, the latter globular and surrounded by the shell-shaped spathe. Sepals hooded. Stamens 4. Fruit consisting of the soft enlarged spadix in which the seeds are sunk.

* * * *Leaves linear, sword-shaped. Spadix on the side of the scape. Flowers with a perianth of 6 sepals. No spathe.*

4. **Ac'orus.** Scape 2-edged, resembling the leaves, the cylindrical spadix borne on one edge. Sepals hollowed. Stamens 6.

1. **ARISÆ'MA**, Martins. INDIAN TURNIP.

1. **A. triphyl'lum**, Torr. (INDIAN TURNIP.) For full description and engraving of this plant see Part I., sections 94–97.

2. **A. Dracontium**, Schott., (GREEN DRAGON) is reported from low grounds near London, Ont. Leaf usually solitary, pedately divided into 7–11 oblong-lanceolate pointed leaflets. Spathe convolute, pointed ; the slender point of the spadix extending beyond it.

2. **CALLA**, L. WATER ARUM.

C. palustris, L. (MARSH CALLA.) This plant is fully described and illustrated in Part I., section 98.

3. **SYMPLOCAR'PUS**, Salisb. SKUNK CABBAGE.

S. fœ'tidus, Salisb. Leaves 1–2 feet long, ovate or heart-shaped, short-petioled. Spathe purplish and yellowish, incurved. Plant with skunk-like odour.—Bogs and wet places ; not common northward.

4. **AC'ORUS**, L. SWEET FLAG. CALAMUS.

A. Cal'amus, L. Scape much prolonged beyond the spadix. —Swamps and wet places.

ORDER XCI. LEMNA'CEÆ. (DUCKWEED FAMILY.)

Very small plants floating about freely on the surface of ponds and ditches, consisting merely of a little frond with a single root or a tuft of roots from the lower surface, and producing minute monœcious flowers from a cleft in the edge of the frond. The flowers are rarely to be seen. The commonest representative with us is

Lemna polyrrhi'za, consisting of little roundish green fronds (purplish beneath) about ¼ of an inch across, and with a *cluster* of little roots from the under surface.

L. minor is also found. *Root single.*

ORDER XCII. TYPHA'CEÆ. (CAT-TAIL FAMILY.)

Aquatic or marsh herbs with linear sword-shaped leaves, erect or floating, and monœcious flowers, either in separate heads or on different parts of the same spike or spadix, but without a spathe and destitute of true floral envelopes. Fruit an achene, 1-seeded,

1. **Ty'pha.** Flowers in a very dense and long cylindrical terminal spike, the upper ones staminate, the lower pistillate, the ovaries long-stalked and surrounded by copious bristles forming the down of the fruit. Leaves sword-shaped, erect, sheathing the stem below.

2. **Sparga'nium.** Flowers in separate globular heads along the upper part of the stem, the higher ones staminate, the lower pistillate, each ovary sessile and surrounded by a few scales not unlike a calyx. Both kinds of heads leafy-bracted. Leaves flat or triangular, sheathing the stem with their bases.

1. TY'PHA, Tourn. CAT-TAIL FLAG.

1. **T. latifo'lia,** L. (COMMON CAT-TAIL.) Stem 5–8 feet high. Leaves *flat*. No space between the staminate and pistillate parts of the spike.—Marshy places.

2. **T. angustifo'lia,** L. (NARROW-LEAVED or SMALL CAT-TAIL.) Leaves *channelled* toward the base, narrowly linear. The two parts of the spike usually with an interval between them.—Central and eastern Ontario.

2. SPARGA'NIUM, Tourn. BUR-REED.

1. **S. eurycar'pum,** Engelm. Stem erect, stout, 2–4 feet high. Leaves mostly flat on the upper side, keeled and hollow-sided on the lower. Heads several, panicled-spiked, the pistillate an inch across in fruit. Nutlets or achenes with a broad abruptly-pointed top.—Borders of slow waters and ponds.

2. **S. simplex,** Hudson, var. **angustifo'lium,** Gray. (*S. affine*, Schnitzlein, in Macoun's Catalogue.) Stem slender, erect, 1–2 feet high; *the leaves usually floating*, long and narrowly linear. Heads several, usually in a simple row, the pistillate *supra-axillary*, about half an inch across. Nutlets pointed at both ends.

Var. **Nuttallii,** Engel., (*S. simplex*, Hudson, in Macoun's Catalogue,) has the lower *pistillate heads axillary*, and the fruiting heads perhaps a little larger.—In slow streams.

ORDER XCIII. NAIADA'CEÆ. (PONDWEED FAMILY.)

Immersed aquatic herbs, with jointed stems and sheathing stipules. Leaves immersed or floating. Flowers (in our common genus) perfect, in spikes or clusters, with 4 sepals, 4 stamens, and 4 ovaries; the spikes generally raised on peduncles to the top of the water. Plants of no very great interest. The most obvious characters of a few species are given here.

POTAMOGE'TON, Tourn. Pondweed.

1. **P. natans,** L. *Submersed leaves grass-like or capillary;* upper stipules *very long, acute.* Spikes cylindrical, all out of the water. Stem hardly branched. Floating leaves *long-petioled,* elliptical, with a somewhat heart-shaped base, with a blunt apex, 21–29-nerved.

2. **P. Claytonii,** Tuckerman. *Stem compressed.* Submersed leaves *linear,* 2–5 inches long, 2-ranked, 5-nerved; stipules *obtuse.* Floating leaves *short-petioled,* chiefly opposite, oblong, 11–17-nerved. Spikes all above water.

3. **P. amplifo'lius,** Tuckerman. Submersed leaves large, *lanceolate or oval,* acute at each end, recurved, wavy; *stipules long and tapering.* Floating leaves large, oblong or lance-ovate, or slightly cordate, long-petioled, 30–50-nerved.

4. **P. gramin'eus,** L. Submersed leaves lanceolate or linear-lanceolate, upper ones petioled, lower ones sessile. *Stipules obtuse.* Floating leaves with a short blunt point, 9–15-nerved. Var. **heterophyl'lus,** Fries., (the common form) has the lower leaves shorter, lanceolate, and more rigid.

5. **P. lucens,** L., var. **minor,** Nolte. *Leaves all submersed,* more or less petioled, oval or lanceolate, *mucronate, shining.* Stem branching.

6. **P. perfolia'tus,** L. Leaves all submersed, varying in width from *orbicular to lanceolate, clasping by a heart-shaped base.* Stem branching.

7. **P. compressus,** Fries. (*P. zosteræfolius,* Schum., in Macoun's Catalogue.) Leaves all submersed, linear, grass-like, sessile, with three large nerves and many fine ones. Stem branching, *wing-flattened.* Stipules free from the sheathing base of the leaf.

8. **P. pectina'tus,** L. Leaves all submersed, bristle-shaped. Stem repeatedly forking, filiform. *Spikes interrupted, on long slender peduncles.* Stipules united with the sheathing base of the leaf.

II. PETALOI'DEOUS DIVISION.

Flowers with a perianth coloured like a corolla.

ORDER XCIV. ALISMA'CEÆ. (WATER-PLANTAIN F.)

Marsh herbs, with flowers having 3 distinct sepals and 3 distinct petals, pistils either apocarpous or separating at maturity into distinct carpels, and hypogynous stamens 6–many. Flowers on scapes or scape-like stems. Leaves sheathing at the base, either rush-like or, when broad, mostly heart-shaped or arrow-shaped.

Synopsis of the Genera.

* *Calyx and corolla both greenish. Carpels more or less united, but spreading at maturity. Leaves rush-like and fleshy, or grass-like.*

1. **Triglo'chin.** Flowers small, in a spike or close raceme, without bracts. Carpels *united to the top;* when ripe, splitting away from a central persistent axis.

2. **Scheuchze'ria.** A low bog-herb, with a creeping jointed rootstock, and grass-like leaves. Stamens 6. Carpels 3, globular, *nearly distinct.*

(These two genera are included in Naiadaceæ in Macoun's Catalogue.)

* * *Calyx green, persistent. Corolla white. Pistil apocarpous. Leaves with distinct blades and petioles.*

3. **Alis'ma.** *Flowers perfect.* Stamens usually 6. Carpels numerous, in a ring. Leaves all radical. *Scape with whorled panicled branches.*

4. **Sagitta'ria.** *Flowers monœcious, sometimes diœcious.* Stamens numerous. Carpels numerous, in more or less globular heads. Leaves arrow-shaped, but varying greatly. Flowers mostly in whorls of 3 on the scapes, the sterile ones uppermost.

1. TRIGLO'CHIN, L. ARROW-GRASS.

1. **T. palus'tre,** L. A slender rush-like plant, 6–18 inches high, found growing in bogs northward. *Carpels 3,* awl-pointed at the base, splitting away from below upwards. Spike or raceme slender, 3 or 4 inches long.

2. **T. marit'imum,** L., is also found occasionally. The whole plant is stouter than No. 1, and the carpels are usually 6 in number.

2. SCHEUCHZE'RIA, L. SCHEUCHZERIA.

S. palustris, L. Stem zigzag. Flowers in a loose terminal raceme, with sheathing bracts.—Bogs.

3. **ALIS'MA**, L. WATER-PLANTAIN.

A. planta'go, L., var. **America'num**, Gray. Leaves long-petioled, mostly oblong-heart-shaped, but often narrower, 3–9-nerved or ribbed, and with cross veinlets between the ribs. Flowers small, white, in a large and loose compound panicle.—Low and marshy places, often growing in the water.

4. **SAGITTA'RIA**, L. ARROW-HEAD.

* *Filaments narrow, as long as the anthers.*

1. **S. varia'bilis**, Engelm. Very variable in size and in the shape of the leaves. Scape angled.—Common everywhere in shallow water.

* * *Filaments very short, with enlarged mostly glandular base.*

2. **S. heterophyl'la**, Pursh. Scape weak and at length procumbent. Leaves lanceolate or lance-ovate, entire, or with one or two narrow basal sagittate appendages.

3. **S. gramin'ea**, Michx. Scape very slender, erect. Leaves varying from ovate-lanceolate to linear, *scarcely ever sagittate.*

ORDER XCV. HYDROCHARIDA'CEÆ. (FROG'S-BIT F.)

Aquatic herbs, with diœcious or polygamo-diœcious flowers on scape-like peduncles from a kind of spathe of one or two leaves, the perianth in the fertile flowers of 6 pieces united below into a tube which is adherent to the ovary. Stigmas 3. Fruit ripening under water.

Synopsis of the Genera.

1. **Anach'aris.** Growing under water, the pistillate flowers alone coming to the surface. Stem leafy and branching. Perianth of the fertile flowers with a 6-lobed spreading limb, the tube prolonged to an extraordinary length, thread-like. Leaves crowded, pellucid, 1-nerved, sessile, whorled in threes or fours. Stamens 3–9.
2. **Vallisne'ria.** Nothing but the pistillate flowers above the surface, these on scapes of great length, and after fertilization drawn below the surface by the spiral coiling of the scapes. Tube of the perianth not prolonged. Leaves linear, thin, long and ribbon-like.

(In both genera the staminate flowers break off spontaneously and float on the surface around the pistillate ones, shedding their pollen upon them.)

1. **ANACH'ARIS**, Richard. WATER-WEED.

A. Canadensis, Richard. (*Elodéa Canadensis*, Planchon, in Macoun's Catalogue.)—Common in slow waters.

2. VALLISNE'RIA, Micheli. TAPE-GRASS. EEL-GRASS.

V. spira'lis, L. Leaves 1–2 feet long.—Common in slow waters.

ORDER XCVI. ORCHIDA'CEÆ. (ORCHIS FAMILY.)

Herbs, well marked by the peculiar arrangement of the stamens, these being *gynandrous*, that is, borne on or adherent to the stigma or style. There is also usually but a single stamen, of two rather widely separated anthers, but in the last genus of the following list there are 2 distinct stamens, with the rudiment of a third at the back of the stigma. As explained in Part I., sections 90–93, the Orchids as a rule require the aid of insects to convey the *pollinia*, or pollen-masses, to the stigma, but occasionally it happens that when the anther-cells burst open the pollinia fall forward and dangle in front of the viscid stigma beneath, being sooner or later driven against it either by the wind or by the head of some insect in pursuit of honey. In all cases where the student meets with an Orchid in flower, he should, by experiment, endeavour to make himself acquainted with the method of its fertilization.

The Orchis Family is a very large one, there being probably as many as 3,000 different species, but the greater number are natives of tropical regions. Many of them are *epiphytes*, or air-plants, deriving their support chiefly from the moisture of the air, through their long aerial roots which never reach the ground. The perianth in many species, and particularly the *labellum*, or lip, assumes the most fantastic shapes, making the plants great favourites for hot-house cultivation. In Canada, the representatives of this great Order, though not very numerous, are among the most interesting and beautiful of our wild flowers. They are, as a rule, bog-plants, and will be found in flower in early summer.

Synopsis of the Genera.

* *Anther only one, but of 2 cells, these separated in the first genus.*

+ *Lip with a spur underneath. Anther on the face of the stigma.*

1. **Orchis.** The 3 sepals and 2 of the petals erect and arching over the centre of the flower; the lip turned down. The 2 glands or viscid disks at the base of the pollen-masses enclosed in a little pouch just over the concave stigma. Leaves 2, large. Flowers few, in a spike.

2. **Habena'ria.** The lateral sepals usually spreading. The glands or viscid disks of the pollen-masses not enclosed in a covering. Flowers in spikes.

+ + *Lip without a spur. Anther on the back of the column. Flowers small, white, in a slender spike.*

3. **Spiran'thes.** Spike (of white or whitish flowers) more or less spirally twisted. Sepals and petals narrow and generally connivent. Lip oblong, the lower part embracing the column, *and with a protuberance on each side at the base.*

4. **Goodye'ra.** Flowers very much as in Spiranthes, *but the lip sac-shaped, and without protuberances at the base.* Leaves white-veiny, in a tuft at the base of the scape.

+ + + *Lip without a spur. Anther on the apex of the style, hinged like a lid.*

++ *Pollen-masses 2 or 4, powdery or pulpy, without stalk or gland.*

5. **Lis'tera.** Flowers small, greenish or brownish-purple, in a spike or raceme. Stem bearing a pair of opposite sessile roundish leaves near the middle. Lip flat, *mostly drooping, 2-lobed at the apex.*

6. **Calopo'gon.** *Ovary not twisted, the lip consequently turned towards the stem.* Flowers large, pink-purple, 2–6 at the summit of the scape ; the lip spreading at the outer end and beautifully bearded above with coloured hairs. Leaf grass-like, only one. Pollen-masses 4.

7. **Arethu'sa.** Flower solitary, large, rose-purple. Lip dilated, recurved-spreading at the end. Sepals and petals lanceolate, nearly alike, arching over the column Pollen-masses 4. Scape low, sheathed, from a globular solid bulb, with a single linear nerved leaf hidden in the sheaths of the scape.

8. **Pogo'nia.** Flower solitary, irregular, large, sweet-scented, pale rose-colour or white. Column club-shaped. Lip crested and fringed. Pollen-masses 2. Stem 6–9 inches high, with a single oval or lance-oblong leaf near the middle, and a smaller one, or bract, near the flower.

++ ++ *Pollen-masses 4, smooth and waxy, attached directly to a large gland: no stalks.*

9. **Calyp'so.** Flower solitary, large, showy, variegated with purple, pink, and yellow. Lip large, inflated, sac-shaped, 2-pointed under the apex. Scape short, from a solid bulb, with a single ovate or slightly heart-shaped leaf below.

++ ++ ++ *Pollen-masses 4 : no stalks or glands.*

10. **Micros'tylis.** Small herbs from solid bulbs ; the scape bearing a single leaf and a raceme of minute greenish flowers. Column very small, terete, with 2 teeth at the top, and the anther between them. Petals thread-like or linear, spreading.

11. **Lip'aris.** Small herbs, from solid bulbs ; the low scape bearing 2 radical leaves and a raceme of a few greenish flowers. Column elongated incurved, margined at the apex, Petals thread-like or linear, spreading, Anther lid-like,

12. **Corallorhi'za.** Brownish or yellowish plants, with the small dull flowers in spikes on scapes which are leafless or have mere sheaths instead of leaves. Rootstocks branching and coral-like. *Perianth gibbous or slightly spurred below.* Lip with 2 ridges on the inner part of the face.

13. **Aplec'trum.** Somewhat like the last, but the perianth is *not gibbous below*, and the rootstock, instead of being coral-like, is slender, and produces each year a solid bulb or corm. Lip with 3 ridges on the palate. Scape with 3 greenish sheaths below.

* * *Anthers 2, one on each side of the stigma, and a triangular body, which is the rudiment of a third, at the back of the stigma. Pollen loose and powdery or pulpy.*

14. **Cypripe'dium.** *Lip a large inflated sac*, into the mouth of which the style is declined. Sepals and the other petals much alike, the former apparently only 2, two of them being generally united into one under the lip. Leaves large, many-nerved. Flowers solitary or few.

1. ORCHIS, L. ORCHIS.

O. specta'bilis, L. (SHOWY ORCHIS.) Scape 4-angled, 4–7 inches high, bearing a few flowers in a spike. The arching upper lip pink-purple, the *labellum* white; each flower in the axil of a leaf-like bract.—Rich woods.

2. HABENA'RIA, Willd., R. Br. REIN-ORCHIS.

1. **H. tridenta'ta,** Hook. *Spike few-flowered*, the flowers very small, greenish-white. *Lip wedge-shaped, truncate and 3-toothed at the apex. Spur slender, longer than the ovary*, curved upwards. Stem less than a foot high, slender, with one oblanceolate leaf below and 2 or 3 much smaller ones above.—Wet woods.

2. **H. vires'cens,** Spreng. Stem 10–20 inches high. Spike of small greenish flowers at first dense, with the bracts longer than the flowers, at length long and loose. Lip oblong, almost truncate at the tip; a tooth on each side at the base, and a nasal protuberance on the face. Spur slender, club-shaped. Leaves ovate-oblong or oblong-lanceolate, the upper ones gradually narrowing and passing into bracts.—Wet places.

3. **H. vir'idis,** R. Br., var. **bracteata,** Reichenbach. (*H. bracteata*, R. Br., in Macoun's Catalogue.) *Spike many-flowered*, close. Flowers small, *greenish*. Lip oblong-linear, 2–3-lobed at the tip, *much longer than the very short and sac-like spur.* Stem 6–12 inches high, *leafy*, the lower leaves obovate, the upper oblong or lanceolate, gradually reduced to bracts much longer than the flowers.

4. **H. hyperbo'rea**, R. Br. Spike many-flowered, *long and dense.* Flowers small, greenish. Lip lanceolate, *entire, about the same length as the slender incurved spur.* Stem 6–24 inches high, *very leafy, the leaves lanceolate and erect,* and the bracts longer than the flowers.—Bogs and wet woods.

5. **H. dilata'ta**, Gray. Not unlike No. 4, but more slender and with *linear leaves* and *white flowers.*

6. **H. rotundifo'lia**, Richardson. (*Orchis rotundifolia*, Gray, in Macoun's Catalogue.) Spike few-flowered, loose. Flowers rose-purple, *the lip usually white, spotted with purple, 3-lobed,* the middle lobe larger and notched, longer than the slender spur. Stem 5–9 inches high, *naked and scape-like above, bearing a single roundish leaf* at the base.—Bogs and wet woods.

7. **H. obtusa'ta**, Richardson. Stem as in the last, but the leaf is obovate or spathulate-oblong. Spike few-flowered, the flowers *greenish-white.* Upper sepal broad and rounded, the others and the petals lance-oblong. Lip *entire,* deflexed, as long as the tapering and curving spur.—Bogs.

8. **H. Hook'eri**, Torr. Spike many-flowered, *strict. Flowers yellowish-green,* the lip lanceolate, pointed, incurved; petals lance-awl-shaped. *Spur slender, acute, nearly an inch long.* Stem scape-like above, *2-leaved at the base, the leaves orbicular.*—Woods.

9. **H. orbicula'ta**, Torr. Spike many-flowered, *loose and spreading.* Flowers *greenish-white.* Lip narrowly linear, obtuse. *Spur curved, more than an inch long, thickened towards the apex.* Scape 2-leaved at the base, the leaves *very large, orbicular, and lying flat on the ground,* shining above, silvery beneath.—Rich woods.

10. **H. blephariglot'tis**, Hook. (WHITE FRINGED-ORCHIS.) Spike many-flowered, open. *Flowers white,* very handsome; *the lip fringed, but not lobed,* at the apex. *Spur thread-shaped, three times as long as the lip.* Stem a foot high, leafy; the leaves oblong or lanceolate, the bracts shorter than the ovaries.—Peat-bogs, &c.

11. **H. leucophæ'a**, Gray. (GREENISH FRINGED-ORCHIS.) Spike as in the last, but the flowers *greenish or yellowish-white.* Petals obovate, minutely cut-toothed. *Lip 3-parted above the stalk-like base, the divisions fan-shaped, fringed.* Spur *gradually*

thickened downward, longer than the ovary. Stem leafy, 2–4 feet high. Leaves oblong-lanceolate; bracts a little shorter than the flowers.—Wet meadows.

12. **H. la'cera,** R. Br. (RAGGED FRINGED-ORCHIS.) Like the last, but the *petals are oblong-linear and entire.* The divisions of the lip also are *narrow* and the *fringe is less copious.*—Bogs and rich woods.

13. **H. psyco'des,** Gray. (PURPLE FRINGED-ORCHIS.) Spike cylindrical, many-flowered, the *flowers pink-purple*, fragrant. Lip fan-shaped, 3-parted above the stalk-like base, *the divisions fringed.* Spur curved, somewhat thickened downward, very long. —Low grounds.

3. SPIRAN'THES, Richard. LADIES' TRESSES.

1. **S. Romanzovia'na,** Chamisso. Spike dense, oblong or cylindrical. Flowers *pure white, in 3 ranks in the spike.* Lip ovate-oblong, contracted below the wavy recurved apex. Stem 5–15 inches high, leafy below, leafy-bracted above; the leaves oblong-lanceolate or linear.—Cool bogs.

2. **S. gra'cilis,** Bigelow. *Flowers in a single spirally twisted rank* at the summit of the very slender scape. Leaves with blades all in a cluster at the base, ovate or oblong. Scape 8–18 inches high.—Sandy plains and pine barrens.

4. GOODYE'RA, R. Br. RATTLE-SNAKE PLANTAIN.

1. **G. repens,** R. Br. *Flowers in a loose 1-sided spike.* Lip with a recurved tip. Scape 5–8 inches high. Leaves thickish, petioled, intersected with whitish veins.—Woods, usually under evergreens.

2. **G. pubes'cens,** R. Br. *Spike not 1-sided.* Plant rather larger than the last, and the leaves more strongly white-veined. —Rich woods.

5. LIS'TERA, R. Br. TWAYBLADE.

1. **L. corda'ta,** R. Br. Raceme crowded; pedicels not longer than the ovary. Lip linear, 2-cleft. Column very short.—Damp cold woods.

2. **L. convallarioi'des,** Nutt. Raceme loose and slender; pedicels longer than the ovary. Lip wedge-oblong, 2-lobed. Column longer than in the last.—Damp thickets.

6. CALOPO'GON, R. Br. CALOPOGON.

94 **C. pulchel'lus,** R. Br. Leaf linear. Scape a foot high. Flowers an inch across.—Bogs.

7. ARETHU'SA, Gronov. ARETHUSA.

A. bulbo'sa, L. A beautiful little bog-plant, bearing a single large flower (rarely 2), with the lip bearded-crested on the face.

8. POGO'NIA, Juss. POGONIA.

P. ophioglossoi'des, Nutt. A bog-plant. Sepals and petals nearly equal and alike. Root of thick fibres.

9. CALYP'SO, Salisb. CALYPSO.

C. borea'lis, Salisb. A beautiful little plant growing in mossy bogs. The lip woolly inside; the petals and sepals resembling each other, lanceolate, sharp-pointed. Column winged.

10. MICROS'TYLIS, Nutt. ADDER'S-MOUTH.

1. **M. monophyl'los,** Lindl. Leaf sheathing the base of the stem, ovate-elliptical. Raceme spiked, long and slender. Lip long-pointed.—Cold swamps.

2. **M. ophioglossoi'des,** Nutt. Leaf near the middle of the stem, ovate, clasping. Raceme *short*. Lip 3-toothed.—Damp woods, not so common as the last.

11. LIP'ARIS, Richard. TWAYBLADE.

L. Lœse'lii, Richard. Lip yellowish-green, mucronate, shorter than the unequal petals and sepals. Leaves elliptical-lanceolate or oblong, keeled.—Bogs.

12. CORALLORHI'ZA, Haller. CORAL-ROOT.

1. **C. inna'ta,** R. Br. Flowers small; the lip whitish or purplish, often crimson-spotted, 3-lobed above the base. Spur very small. Stem slender, brownish-yellow, *with a few-flowered spike.*—Swamps.

2. **C. multiflo'ra,** Nutt. *Spike many-flowered.* Stem purplish, stout. Lip deeply 3-lobed. Spur more prominent than in No. 1. —Dry woods.

3. **C. Macræ'i,** Gray. (*C. striata*, Lindl., in Macoun's Catalogue.) Spike crowded, of numerous large flowers, *all the parts*

of the perianth strikingly marked with 3 dark lines. Lip not lobed. Spur none, but the base of the perianth gibbous.—Rich woods; not common.

13. **APLEC'TRUM**, Nutt. PUTTY-ROOT. ADAM-AND-EVE.

A. hyema'le, Nutt. Scape a foot high. Perianth greenish-brown.—Rich mould in woods.

14. **CYPRIPE'DIUM**, L. LADY'S SLIPPER. MOCCASIN-FLOWER.

* *The three sepals separate.*

1. **C. arieti'num**, R. Br. (RAM'S-HEAD LADY'S SLIPPER.) The smallest species. Stem slender, 6–10 inches high, leafy. Leaves 3 or 4, elliptical-lanceolate, nearly smooth. Lip only half an inch long, red and whitish veiny, prolonged at the apex into a deflexed point.—Swamps; rare.

* * *Two sepals united into one piece under the lip.*

2. **C. parviflo'rum**, Salisb. (SMALLER YELLOW LADY'S SLIPPER.) Stem leafy to the top, 1–3-flowered. Lip yellow, *flattish above*, rather less than an inch long. Sepals and petals wavy-twisted, brownish, pointed, longer than the lip.—Bogs and wet woods.

3. **C. pubes'cens**, Willd. (LARGER YELLOW L.) Lip flattened *laterally*, rounded above, larger than in No. 1, but the two species are not sufficiently distinct.

4. **C. specta'bile**, Swartz. (SHOWY L.) *Lip very large, white, pinkish in front.* Sepals and petals *rounded*, *white*, not longer than the lip.—Bogs.

5. **C. acau'le**, Ait. (STEMLESS L.) *Scape naked*, 2-leaved *at the base, 1-flowered. Lip rose-purple*, split down the whole length in front, veiny. Sepals and petals greenish.—Dry or moist woods, under evergreens.

ORDER XCVII. IRIDA'CEÆ. (IRIS FAMILY.)

Herbs with equitant leaves and perfect flowers. The 6 petal-like divisions of the perianth in 2 (similar or dissimilar) sets of 3 each; the tube adherent to the 3-celled ovary. Stamens 3, distinct or monadelphous, opposite the 3 stigmas, and with anthers extrorse, that is, on the outside of the filaments, facing the divisions of the perianth and opening on that side. Flowers from leafy bracts. (See Part I., sections 88 and 89.)

Synopsis of the Genera.

1. **Iris.** The 3 outer divisions of the perianth reflexed, the 3 inner erect and smaller. Stamens distinct, the anther of each concealed under a flat and petal-like arching stigma. The styles below adherent to the tube of the perianth. Pod 3-angled. Flowers blue, large and showy. Leaves sword-shaped or grass-like.
2. **Sisyrin'chium.** The 6 divisions of the perianth alike, spreading. Stamens monadelphous. Stigmas thread-like. Pod globular, 3-angled. Stems 2-edged. Leaves grass-like. Flowers blue, clustered, from 2 leafy bracts. Plants low and slender.

1. IRIS, L. Flower-de-Luce.

1. **I. versic'olor**, L. (Larger Blue Flag.) Stem stout and leafy, from a thickened rootstock. Leaves sword-shaped. Flowers violet-blue, 2 or 3 inches long. Inner petals much smaller than the outer.—Wet places.

2. **I. lacus'tris**, Nutt. (Lake Dwarf Iris.) Stem low, 3–6 inches high. Inner petals nearly equal to the outer. Tube of the perianth slender, less than an inch long, dilated upwards, rather shorter than the divisions of the perianth. Leaves lanceolate, 3–5 inches long.—Shore of Lake Huron.

2. SISYRIN'CHIUM, L. Blue-eyed Grass.

S. Bermudia'na, L., var. **anceps**, Gray. (*S. anceps*, Cav., in Macoun's Catalogue.) A pretty little plant, rather common in moist meadows among grass. The divisions of the delicate blue perianth obovate, notched at the end, and bristle-pointed from the notch. Roots fibrous.

Order XCVIII. AMARYLLIDA'CEÆ. (Amaryllis F.)

Bulbous and scape-bearing herbs, with linear flat root-leaves, and regular and perfect 6-androus flowers, the tube of the petal-like 6-parted perianth adherent to the 3-celled ovary. Lobes of the perianth imbricated in the bud. Style single. Anthers introrse.—Represented with us by one species of the genus

HYPOX'YS, L. STAR-GRASS.

H. erecta, L. A small herb sending up a slender scape from a solid bulb. Leaves linear, grass-like, longer than the umbellately 1–4-flowered scape. Perianth hairy and greenish outside, yellowish within, 6-parted nearly down to the ovary. Stamens 6, sagittate. Pod indehiscent, crowned with the withered perianth.—Meadows and open woods.

ORDER XCIX. DIOSCOREA'CEÆ. (YAM FAMILY.)

Represented with us by the genus

DIOSCORE'A, Plumier. YAM.

D. villo'sa, L. (WILD YAM-ROOT.) A slender twiner with knotted rootstocks, and net-veined, heart-shaped, 9–11-ribbed, petioled leaves. Flowers diœcious, small, in axillary racemes. Stamens 6. Pod with three large wings.—Reported only from the warm and sheltered valley lying between Hamilton and Dundas, Ont., and the banks of the Thames at London, Ont.

ORDER C. SMILA'CEÆ. (SMILAX FAMILY.)

Climbing plants, more or less shrubby, with alternate *ribbed and net-veined* petioled leaves, and small diœcious flowers in umbels. Perianth regular, of 6 greenish sepals, free from the ovary. Stamens as many as the sepals, with 1-celled anthers. Ovary 3-celled, surmounted by 3 sessile spreading stigmas. Fruit a small berry. Represented by the single genus

SMILAX, Tourn. GREEN-BRIER. CAT-BRIER.

(Included in Liliaceæ, in Macoun's Catalogue.)

1. **S. his'pida,** Muhl. *Stem woody, densely covered below with long weak prickles.* Leaves large, ovate or heart-shaped, pointed, thin, 5–9-nerved. Peduncles of the axillary umbels *much longer than the petioles.* Berry black.—Moist thickets.

2. **S. rotundifo'lia,** L., var. **quadrangularis,** Gray. (*S. quadrangularis*, Pursh, in Macoun's Catalogue.) *Stem woody*, it and the branches armed with *scattered prickles. Branches 4-angular.* Peduncles *not longer than the petioles.* Leaves ovate, broader than long, slightly cordate. Berry blue-black.—Southwestern Ontario.

3. **S. herba'cea**, L. (CARRION-FLOWER.) *Stem herbaceous, not prickly.* Leaves ovate-oblong and heart-shaped, 7–9-ribbed, long-petioled, mucronate. Flowers carrion-scented. Berry bluish-black.—Meadows and river-banks.

ORDER CI. LILIA'CEÆ. (LILY FAMILY.)

Herbs, distinguished as a whole by their regular and symmetrical flowers, having a 6-leaved perianth (but 4-leaved in one species of Smilacina) free from the usually 3-celled ovary, and as many stamens as divisions of the perianth (*one before each*) with 2-celled anthers. Fruit a pod or berry, generally 3-celled. The outer and inner divisions of the perianth coloured alike, except in the genus Trillium. (See Part I., sections 82–87, for description of typical plants of this Order.)

Synopsis of the Genera.

* *Leaves net-veined, all in one or two whorls. The stem otherwise naked, rising from a fleshy rootstock. Styles 3.*

1. **Tril'lium.** Leaves 3, in a whorl at the top of the stem. Divisions of the perianth in 2 sets, the outer green, the inner coloured. (See Part I., sections 85 and 86.)
2. **Mede'ola.** Leaves in 2 whorls, the lower near the middle of the stem, and consisting of 5–9 leaves, the upper of (generally) 3 small leaves, near the summit. Stem tall, covered with loose wool. Flowers small, in an umbel. Divisions of the perianth alike, greenish-yellow, recurved. Anthers turned outwards. Styles thread-shaped. Berry globular or nearly so, dark purple.

* * *Leaves straight-veined, linear, grass-like, alternate. Stems simple or tufted. Styles 3.*

3. **Zygade'nus.** Flowers rather large, perfect or polygamous, greenish-white, in a few-flowered panicle; the divisions of the perianth each with a conspicuous obcordate spot or gland on the inside, near the narrowing base. Stem smooth and glaucous, *from a coated bulb.*
4. **Tofield'ia.** Flowers small, perfect, greenish-white, in a terminal raceme or spike, which, however, develops from above downward; the pedicels in clusters of 3, from little involucres of 3 bracts. Pod triangular. Roots *fibrous.* Stem leafy at the base only, in our species *sticky.* Leaves 2-ranked, equitant.

* * * *Leaves straight-veined, but broad (not grass-like), alternate. Stem from a rootstock or fibrous roots, at all events not from a bulb. Style one at the base, but more or less divided into 3 above.*

+ *Perianth of completely separate pieces (polyphyllous).*

5. **Uvula'ria.** Stem leafy, *forking above.* Flowers yellow, at least an inch long, drooping, lily-like, usually solitary (but occasionally in pairs) at

the end or in the forks of the stem. Style *deeply* 3-cleft. Pod triangular. *Leaves clasping-perfoliate or sessile.*

6. **Clinto'nia.** *Stemless*, the naked scape sheathed at the base by 2, 3, or 4 large oblong or oval ciliate leaves. Flowers few, greenish-yellow, in an umbel at the top of the scape. Filaments long and slender. Style long, the stigmas hardly separate. Berry blue.

7. **Prosar'tes.** Downy low herbs, branching above. Flowers greenish, bell-shaped, rather large, solitary or in pairs, drooping on terminal slender peduncles. Sepals taper-pointed. Stigmas 3. Leaves ovate-oblong, taper-pointed, closely sessile, downy underneath. Berry oblong, pointed, red.

8. **Strep'topus.** Stem leafy and forking. Flowers small, not quite in the axils of the ovate clasping leaves, *on slender peduncles which are abruptly bent near the middle.* Anthers arrow-shaped, *2-horned at the apex.*

+ + *Perianth of one piece (gamophyllous).*

9. **Smilaci'na.** Flowers small, white, in a terminal raceme. Perianth 6-parted, *but 4-parted in one species*, spreading. Style short and thick. Stigma obscurely lobed. Filaments slender.

10. **Polygona'tum.** Flowers small, greenish, nodding, *mostly in pairs* in the axils of the nearly sessile leaves. Perianth cylindrical, 6-lobed at the summit, *the 6 stamens inserted on or above the middle of the tube.* Stem simple, from a long and knotted rootstock. Leaves glaucous beneath.

* * * * *Leaves straight-veined, not grass-like. Stem from a coated or scaly bulb. Style 1, not divided above, but the stigma sometimes 3-lobed. Fruit a pod, splitting open midway between the partitions (loculicidal).*

11. **Lil'ium.** *Stem leafy*, from a *scaly* bulb, *the leaves often whorled or crowded.* Anthers at first erect, *at length versatile.* Style long, rather club-shaped. Stigma 3-lobed. Pod oblong. Flowers large and showy, one or more.

12. **Erythro'nium.** For full description see Part I., sections 82 and 83. (Dog's-tooth Violet.)

13. **Allium.** *Scape naked*, from a *coated* bulb. Flowers in an umbel, from a spathe. Style thread-like. *Strong-scented plants.*

1. TRIL'LIUM, L. Wake-Robin.

1. **T. grandiflo'rum**, Salisb. (Large White Trillium.) *Leaves sessile*, longer than broad. *Peduncle erect.* Petals *white* (rose-coloured when old), *obovate.*—Rich woods.

2. **T. erectum**, L. (*T. erectum*, L., var. *atropurpureum*, Hook., in Macoun's Catalogue.) (Purple Trillium.) *Leaves sessile*, about as broad as long. *Peduncle erect.* Petals dull

purple, *ovate*.—Rich woods. Var. **album,** *with greenish-white petals*, is found along with the purple form. It does not appear to be clearly distinguished from No. 1.

3. **T. cer'nuum,** L. *Leaves sessile* or nearly so, broadly rhomboid, abruptly pointed. *Peduncle recurved under the leaves.* Petals white, oblong-ovate, acute.—Chiefly eastward.

4. **T. erythrocar'pum,** Michx. (PAINTED TRILLIUM.) *Leaves distinctly petioled*, rounded at the base. Petals pointed, white, *with purple stripes inside at the base.*—Not uncommon northward in damp woods and low grounds.

2. MEDE'OLA, Gronov. INDIAN CUCUMBER-ROOT.

M. Virgin'ica, L. Stem 1–3 feet high.—Rich woods.

3. ZYGADE'NUS, Michx. ZYGADENE.

Z. glaucus, Nutt. Not uncommon in bogs and beaver-meadows northward. Leaves flat and pale.

4. TOFIELD'IA, Hudson. FALSE ASPHODEL.

T. glutino'sa, Willd. Stem and pedicels very sticky with dark glands. Leaves short.—Lake Huron coast.

5. UVULA'RIA, L. BELLWORT.

1. **U. grandiflo'ra,** Smith. Leaves clasping-perfoliate. Rootstock short.—Rich woods.

2. **U. sessilifo'lia,** L. Leaves *sessile* or partly clasping, lance-oblong. Rootstock *creeping.*—Eastward.

6. CLINTO'NIA, Raf. CLINTONIA.

C. borea'lis, Raf. Umbel 2–7-flowered. Leaves 5–8 inches long. Perianth pubescent outside.—Damp woods, often under evergreens.

7. PROSAR'TES, Don. PROSARTES.

P. lanugino'sa, Don. (*Disporum lanuginosa*, Don., in Macoun's Catalogue.)—Rich woods, western Ontario.

8. STREP'TOPUS, Michx. TWISTED-STALK.

S. ro'seus, Michx. Flowers rose-purple.—Damp woods.

9. **SMILACI'NA**, Desf. FALSE SOLOMON'S SEAL.

1. **S. racemo'sa**, Desf. (FALSE SPIKENARD.) *Raceme compound.* Stem pubescent, 2 feet high. Leaves many, oblong, taper-pointed, ciliate. Berries speckled with purple.—Rich woods and thickets.

2. **S. stella'ta**, Desf. *Raceme simple.* Stem nearly smooth, 1–2 feet high. Leaves 7–12, oblong-lanceolate, slightly clasping. Berries black.—Moist woods and copses.

3. **S. trifo'lia**, Desf. *Raceme simple.* Stem low (3–6 inches), glabrous. Leaves usually 3, oblong, the bases sheathing. Berries red.—Bogs.

4. **S. bifo'lia**, Ker., var. **Canadensis**, Gray. (*Maianthemum Canadense*, Desf., in Macoun's Catalogue.) Distinguished at once by the *4-parted perianth and the 4 stamens.* Raceme simple. Stem 3–5 inches high. Leaves usually 2, but sometimes 3.—Moist woods.

10. **POLYGONA'TUM**, Tourn. SOLOMON'S SEAL.

1. **P. biflo'rum**, Ell. (SMALLER SOLOMON'S SEAL.) Stem slender, 1–3 feet high. Leaves ovate-oblong or lance-oblong. Peduncles mostly 2-flowered. Filaments *hairy.*—Rich woods.

2. **P. gigante'um**, Dietrich, (GREAT S.) is occasionally met with westward and south-westward. The stem is taller and stouter than in the last, the peduncles *several-flowered*, and the filaments are *not hairy.*

11. **LIL'IUM**, L. LILY.

1. **L. Philadel'phicum**, L. (WILD ORANGE-RED LILY.) Divisions of the perianth *narrowed into claws* below, not recurved at the top. Flowers *erect*, 1–3, orange, spotted with purple inside. Leaves linear-lanceolate, the upper mostly in whorls of 5–8.—Sandy soil.

2. **L. Canadense**, L. (WILD YELLOW LILY.) Divisions of the perianth *recurved above the middle.* Flowers *nodding*, few, orange, spotted with brown inside. Leaves remotely whorled, 3-ribbed.—Swamps and wet meadows.

3. **L. super'bum**, L. (*L. Carolinianum*, Michx., in Macoun's Catalogue.) (TURK'S-CAP LILY.) Divisions of the perianth *very*

strongly recurved. Flowers nodding, *often numerous*, in a pyramidal raceme, bright orange, dark-purple-spotted within. Lower leaves whorled, 3-ribbed or nerved. Stem taller than either of the first two, 3–7 feet.—Rich low grounds, commoner southward and south-westward.

12. ERYTHRO'NIUM, L. DOG'S-TOOTH VIOLET.

E. America'num, Smith. (YELLOW ADDER'S TONGUE.) Perianth light yellow, sometimes spotted at the base.—Copses and rich meadows.

13. ALLIUM, L. ONION. LEEK.

1. **A. tricoc'cum**, Ait. (WILD LEEK.) Leaves *flat, lance-oblong*, 5–9 inches long, 1–2 inches wide, appearing in early spring and withering before the flowers are developed. Sepals *white*. Pod strongly 3-lobed. Scape 9 inches high.—Rich woods.

2. **A. Canadense**, Kalm. (WILD GARLIC.) Leaves *narrowly linear*. Ovary crested with 6 teeth. Umbel few-flowered, *often bearing a head of bulbs instead of flowers*. Sepals pale rose-colour.—Eastward, in moist meadows.

ORDER CII. JUNCA'CEÆ. (RUSH FAMILY.)

Grass-like or sedge-like plants, with, however, flowers similar in structure to those of the last Order. Perianth greenish and glumaceous, of 6 divisions in 2 sets of 3 each. Stamens 6 (occasionally 3). Style 1. Stigmas 3. Pod 3-celled, or 1-celled with 3 placentæ on the walls. The plants of the Order are not of any very great interest to the young student, and the determination of the species is rather difficult. A brief description of a few of the most common is given here, as an easy introduction to the study of the Order with the aid of more advanced text-books.

Synopsis of the Genera.

1. **Lu'zula.** Plant less than a foot high. Leaves linear or lance-linear, flat, *usually hairy. Pod 1-celled, 3-seeded.* Flowers in umbels or in spikes. Plants usually growing in *dry* ground.

2. **Juncus.** Plants *always smooth*, growing in water or *wet soil.* Flowers small, greenish or brownish, panicled or clustered. Pod 3-celled, *many-seeded.*

1. LU'ZULA, DC. Wood-Rush.

1. **L. pilo'sa,** Willd. Flowers umbelled, long-peduncled, brown-coloured. Sepals pointed.—Shady banks.

2. **L. campestris,** DC., has the flowers (light brown) in 4–12 spikes, the spikes umbelled. Sepals bristle-pointed.—Fields and woods.

2. JUNCUS, L. Rush.

* *Scapes simple and leafless, but with sheaths at the base. Flowers in sessile panicles, apparently from the side of the scape, owing to the involucral leaf being similar to and continuing the scape.*

1. **J. effu'sus,** L. (Common or Soft Rush.) Scape 2–4 feet high, soft and pliant, furnished at the base with merely *leafless sheaths*, the inner sheaths awned. Panicle many-flowered. Flowers small, *greenish, only 1 on each pedicel. Stamens 3.* Pod *greenish-brown*, triangular-obovate, *not pointed.*—Marshes.

2. **J. filifor'mis,** L., has a very slender scape (1–2 feet high), fewer flowers than No. 1, and *6 stamens* in each. Pod *greenish*, broadly-ovate, and *short-pointed. No leaves.*

3. **J. Bal'ticus,** Dethard. Scape *rigid*, 2–3 feet high. *No leaves.* Panicle loose. Flowers brownish. Pod elliptical, somewhat triangular, obtuse but pointed, *deep-brown.*

* * *Stem leafy at the base or throughout; the leaves flat or channelled, but never knotted. Panicle terminal.*

4. **J. bufo'nius,** L. Stem *leafy*, slender, 3–9 inches high, branching from the base. Panicle terminal, spreading. Flowers greenish, single on the *pedicels.* Sepals awl-pointed, the outer set much longer than the inner and than the blunt pod. *Stamens 6.*—Ditches along roadsides.

5. **J. ten'uis,** Willd. Stems *leafy below*, wiry, 9–18 inches high, *simple*, tufted. Panicle loose, shorter than the slender involucral leaves. Flowers greenish, single on the pedicels; the sepals longer than the blunt pod. *Seeds white-pointed at both ends.*—Open low grounds.

* * * *Stem leafy; the leaves terete or laterally compressed, knotted by internal cross-partitions. Panicle terminal, the flowers mostly in heads.*

+ *Stamens 6.*

6. **J. pelocar'pus,** E. Meyer. Stems slender and erect, 6–18 inches high. Leaves few, thread-like, slightly knotted. Flowers greenish with red, *single or in pairs* in the forks and along one

side of the branches of the panicle, and often with accompanying tufts of leaves. The 3 inner sepals longer than the outer ones, but shorter than the oblong taper-beaked 1-celled pod. Seeds obovate, short-pointed.

7. **J. alpi'nus,** Villars, var. **insignis,** Fries. Stems erect, 9–18 inches high, with 1 or 2 slender leaves. Branches of the meagre panicle erect, bearing *numerous* greenish or brownish *heads* of 3–6 flowers each. Outer sepals mucronate or cuspidate, and longer than the rounded inner ones. Pod short-pointed, light-brown. Seeds spindle-shaped.

8. **J. nodo'sus,** L. Stem erect, 6–15 inches high, slender, from a creeping slender and *tuber-bearing* rootstock, usually with 2 or 3 slender leaves. *Heads few*, 8–20-flowered, and overtopped by the involucral leaf. Flowers brown. Pod slender, taper-pointed, 1-celled. Seeds obovate, mucronate.

+ + *Stamens 3. Seeds tailed.*

9. **J. Canadensis,** J. Gay, var. **coarcta'tus,** Engel. Stems slender, 9–18 inches high, tufted, bearing 2 or 3 leaves. Panicle somewhat erect, contracted; the heads 3–5-flowered, deep-brown. Pod prismatic, abruptly pointed, deep-brown. Seeds slender, with short tails.—A very late-flowering species.

ORDER CIII. PONTEDERIA'CEÆ. (PICKEREL-WEED F.)

The most common representatives of this Order with us are

1. PONTEDE'RIA, L. PICKEREL-WEED.

P. corda'ta, L. A stout plant growing in shallow water, sending up a scape bearing a single large arrow-heart-shaped blunt leaf, and *a spike of violet-blue flowers with a spathe-like bract.* Perianth 2-lipped, the 3 upper divisions united, the 3 lower spreading, the whole revolute-coiled after flowering, the fleshy base enclosing the fruit. Stamens 6, 3 of them exserted on long filaments, the rest short.

2. SCHOL'LERA, Schreber. WATER STAR-GRASS.

S. gramin'ea, Willd. (*Heteranthera graminea*, Vahl., in Macoun's Catalogue.) A grass-like herb, wholly under water, only the small yellowish flowers reaching the surface, the latter single, from spathes. Perianth salver-shaped, regular. Stamens 3, anthers sagittate.

ORDER CIV. ERIOCAULONA'CEÆ. (PIPEWORT F.)

Represented with us by the genus

ERIOCAU'LON, L. PIPEWORT.

E. septangula're, Withering. A slender plant with a naked scape 2–6 inches high, growing in shallow water in the margins of our northern ponds. Leaves short, awl-shaped, in a tuft at the base. Flowers in a small woolly head at the summit of the scape, monœcious. Perianth double; the outer set or calyx of 2–3 keeled sepals; the corolla tubular in the sterile flowers and of 2–3 separate petals in the fertile ones. Scape 7-angled. The head (except the beard) lead-coloured.

III. GLUMA'CEOUS DIVISION.

Flowers without a proper perianth, but subtended by thin scales called *glumes.*

This Division includes two very large Orders—Cyperaceæ and Gramineæ—both of which present many difficulties to the beginner. Accordingly no attempt will be made here to enumerate and describe all the commonly occurring species of these Orders. In chapter XIV., Part I., the student will find descriptions and illustrations of several typical Grasses. We shall here, therefore, only describe two or three of the commonest representatives of the Order Cyperaceæ, so as to put the beginner in a position to continue his studies with the aid of Gray's Manual or other advanced work.

ORDER CV. CYPERA'CEÆ. (SEDGE FAMILY.)

Grass-like or rush-like herbs, easily distinguished from Grasses by the sheaths of the leaves, which in the Sedges are *closed* round the culm, not split. Flowers in spikes, each flower in the axil of a glume-like bract, either altogether without a perianth or with a few bristles or scales inserted below the ovary. Ovary 1-celled, becoming an achene (2- or 3-angled). Style 2- or 3-cleft. Stamens mostly 3, occasionally 2.

We shall describe one species of each of five genera.

1. CYPE'RUS DIANDRUS.

The plant (Fig. 256) is from 4 to 10 inches in height. The culm is *triangular*, leafy towards the base, but naked above. At the summit there is an umbel the rays of which are unequal in length, and on each ray are clustered several *flat brown-coloured* spikes, the scales of which are imbricated in two distinct rows. At the base of the umbel there are 3 leaves of very unequal length, forming a sort of involucre, and the base of each ray of the umbel is sheathed. In each spike every scale except the lowest one contains a flower in its axil. The flower (Figs. 257 and 258) is entirely destitute of perianth, and consists of 2 *stamens and an ovary surmounted by a 2-cleft style*, being consequently *perfect*. —The plant is pretty easily met with in low wet places.

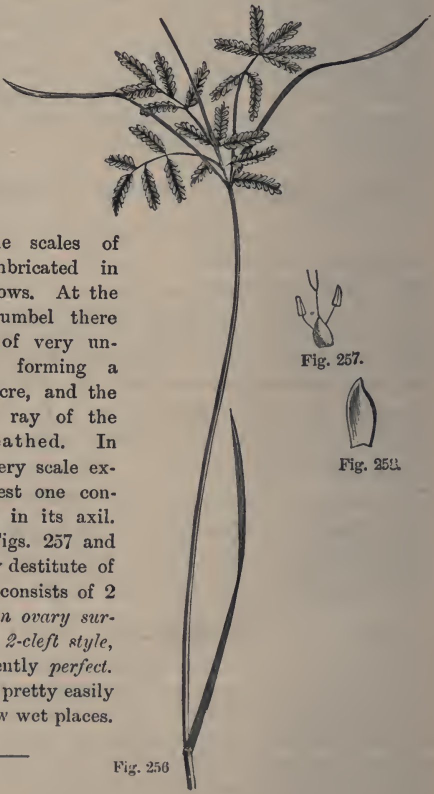

Fig. 256

Fig. 257.

Fig. 258.

2. ELEOCH'ARIS OBTU'SA.

In this plant, which grows in muddy soil in tufts 8 to 14 inches in height, there is but a single spike at the summit of each slender culm, and the scales of the spikes, instead of being imbricated in 2 rows and thus producing a flat form, are *imbricated all round.* The scales are very thin in texture, with a midrib somewhat thicker, and are usually brownish in colour. Each of them contains a perfect flower in its axil. Instead of a perianth, there are *6 or 8 hypogynous barbed bristles.* The stamens (as is generally the case in this Order) are 3 in number, and the style is usually 3-cleft. Observe that the style is enlarged into a sort of bulb at the base, *this bulbous portion persisting as a flattish tubercle on the apex of the achene.* The culms are without leaves, being merely sheathed at the base.

3. SCIRPUS PUNGENS.

A stout marsh-plant, 2 or 3 feet high, with a sharply triangular hollow-sided culm, and bearing at the base from 1 to 3 channelled or boat-shaped leaves. The rusty-looking spikes vary in number from 1 to 6, and are in a single sessile cluster which appears to spring from the side of the culm, owing to the 1-leaved involucre resembling the culm and seeming to be a prolongation of it. Each scale of the spike is 2-cleft at the apex, and bears a point in the cleft. The flowers are perfect, with 2 to 6 bristles instead of perianth, 3 stamens, and a 2-cleft style, *but there is no tubercle on the apex of the achene.* The culms of this plant spring from stout running rootstocks.

4. ERIOPH'ORUM POLYSTACH'YON.

A common bog-plant in the northern parts of Canada, resembling Scirpus in the details as to spikes, scales, &c., but differing chiefly in this, that the bristles of the flowers are very delicate and become very long after flowering, so that *the spike in fruit looks like a tuft of cotton.* The culm of our plant is triangular, though not manifestly so, and its leaves are hardly, if at all, channelled. The spikes are several in number, and are on nodding peduncles, and the involucre consists of 2 or 3 leaves. Culm 15 or 20 inches high.

5. CAREX INTUMES'CENS.

The species of the genus Carex are exceedingly numerous and difficult of study. The one we have selected (Fig. 259) is one of the commonest and at the same time one of the easiest to examine. In this genus the flowers are monœcious, the separate kinds being either borne in different parts of the same spike or in different spikes. The genus is distinguished from all the others of this Order by the fact of the achene *being enclosed in a bottle-shaped more or less inflated sac*, which is made by the union of the edges of two inner bractlets or scales. To this peculiar sac (Figs. 260 and 261) which encloses the achene the name *perigynium* is given. The culms are always triangular and the leaves grass-like, usually roughened on the margins and on the keel.

In the species under examination (which may be found in almost any wet meadow) the culm is some 18 inches high. The staminate spike (only one) is separate from and *above* the fertile ones, which are 2 or 3 in number, few- (5 to 8) flowered, and quite near together. The perigynia are very much inflated, that is, very much larger than the achenes; they are distinctly marked with many nerves, and taper gradually into a long 2-toothed beak from which protrude the 3 stigmas. The bracts which subtend the spikes are leaf-like, and extend much beyond the top of the culm.

Fig. 259.

Fig. 260.

Fig. 261.

ORDER CVI. GRAMIN'EÆ. (GRASS FAMILY.)

Herbs somewhat resembling those of the last Order, but the culms are hollow except at the joints, and the sheaths of the leaves are split on the opposite side of the culm from the blade.

SERIES II.

FLOWERLESS OR CRYPTOG'AMOUS PLANTS.

Plants not producing true flowers, but reproducing themselves by means of *spores* instead of seeds, the spores consisting merely of simple cells, and not containing an embryo.

This series is subdivided into three classes:

1. **Pteridophytes,** embracing Ferns, Horsetails, and Club-Mosses.

2. **Bryophytes,** embracing the true Mosses and Liverworts.

3. **Thallophytes,** embracing Algæ and Fungi.

Types of all of these have already been described and illustrated in Part I. We shall here enumerate the common representatives of the Pteridophytes only.

FERNS.

These beautiful plants are favourites everywhere, and we shall therefore enter into a description of their characteristics with sufficient minuteness to enable the young student to determine with tolerable certainty the names of such representatives of the Family as he is likely to meet with commonly.

In Chapter XXI. of Part I. will be found a full account of the common Polypody, with which it is assumed the student is already familiar.

Fig. 262 shows a portion of the frond of the Common Brake (Pteris aquilina). Here the frond is several times compound. The first or largest divisions to the right and left are called *pinnæ*.

The secondary divisions (or first divisions of the pinnæ) are the *pinnules*. The stem, as in the Polypody, and in fact in all our Ferns which have a stem at all, is a rootstock or rhizome. But here we miss the fruit-dots or sori, so conspicuous in our first example. In this case it will be found that there is a *continuous line of sporangia around the margin* of every one of the pinnules of the frond, and that the edge of the pinnule is reflexed *so as to cover the line of spore-cases.* Fig. 263 is a very much magnified view of one of the lobes of a pinnule,

Fig. 263.

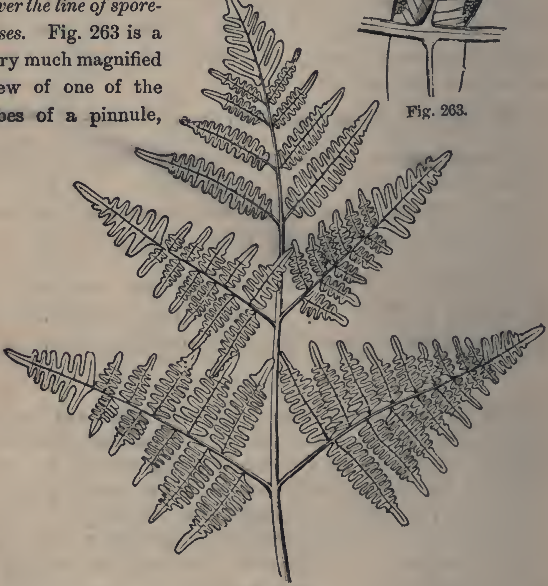

Fig. 262.

with the edge rolled back to show the sporangia. Some of the sporangia are removed to show a line which runs across the ends of the forking veins. To this the sporangia are attached. The veins, it will be seen, do not form a net-work, and so are free, as in Polypody. Observe, then, that in Polypody the sori are not covered, whilst in Pteris the opposite is the case. The covering of the fruit-dots is technically known as the *indusium.* The individual spore-cases are alike in both plants.

Fig. 264 shows a frond of one of our commonest Shield-Ferns (Aspidium acrostichoides). It is simply pinnate. The stipe is thickly beset with rusty-looking, chaff-like scales. The veins are free, as before. The *sori* or *fruit-dots* are on the back of the upper pinnæ, but they are neither collected in naked clusters, as in Polypody, nor are they covered by the edge of the frond as in the Brake. Here each cluster has an *indusium* of its own. The indusium is round, and attached to the frond by its depressed centre (peltate). Fig. 265 shows an enlarged portion of a pinna, with the sporangia escaping from beneath the indusium. From one forking vein the sporangia are stripped off to show where they have been attached. The separate sporangia discharge their spores in the manner represented in the account of Polypody.


Fig. 264.

In some Ferns the fruit-dots are elongated instead of being round, and the indusium is attached to the frond by *one edge* only, being free on the other. Sometimes two long fruit-dots will be found side by side, the free edges of the indusia being towards each other, so that there is the *appearance* of one long fruit-dot with an indusium split down the centre.

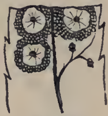
Fig. 265.

Fig. 266 represents a frond of a very common swamp Fern, Onoclea Sensibilis, or Sensitive Fern. It is deeply pinnatifid, and on one of the lobes the veining is represented. Here the veins are *not* free, but as they form a net-work they are said to be *reticulated*. You will look in vain on this frond for fruit-dots, but beside it grows

Fig. 267.

Fig. 266.

Fig. 268.

Fig. 269.

another, very different in appearance,—so different that you will hardly believe it to be a frond at all. It is shown in Fig. 267. It is twice pinnate, the pinnules being little globular bodies, one of which, much magnified, is shown in Fig. 268. You may open out one of these little globes, and then you will have something like what is shown in an enlarged form in Fig. 269. It now looks more like a pinnule than when it was rolled up, and it now also displays the fruit-dots on the veins inside. Here, then, we have evidently two kinds of frond. That bearing the fruit-dots we shall call the *fertile* frond, and the other we shall call the *sterile* one. You must not look upon the pinnule in which the sori are wrapped up as an indusium. Sori which are wrapped up in this way have an indusium of their own besides, but in this plant it is so obscure as to be very difficult to observe.

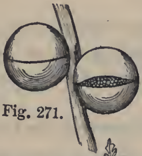

Fig. 271.

The spore-cases burst open by means of an elastic ring as before.

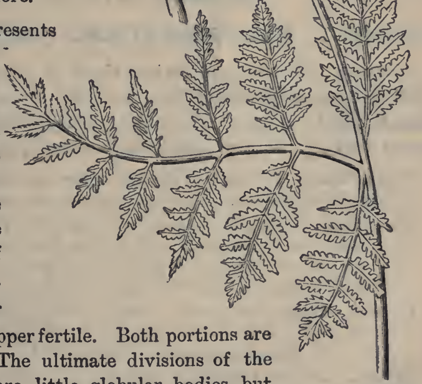

Fig. 270.

Fig. 270 represents one of the Moonworts (Botrychium Virginicum), very common in our rich woods everywhere. Here we have a single frond, but made up manifestly of two distinct portions, the lower sterile and the upper fertile. Both portions are thrice-pinnate. The ultimate divisions of the fertile segment are little globular bodies, but you cannot unroll them as in the case of the Onoclea. Fig. 271 shows a couple of them greatly enlarged. There is a slit across the middle of each, and one of the slits is partially open, disclosing the *spores* inside. Each little globe is, in fact, a *spore-case* or *sporangium*, so that here we have something quite different from what we have so far met with. Up to this point we have found the sporaniga collected into dots or lines or clusters of some sort. In the Moonwort the sporangia are separate and naked, and instead of bursting through the action of an elastic ring, they open by a horizontal slit and discharge their spores. In other Ferns, as the Osmunda, the sporangia are somewhat similar, but burst open by a *vertical* instead of a horizontal slit.

Observe that the frond of Botrychium is *not circinate* in the bud.

We shall now proceed to describe the commonly occurring representatives of the Fern Family.

ORDER CVII. **FILICES.** (FERN FAMILY.)

Flowerless plants with distinct leaves known as *fronds*, these circinate in the bud, except in one suborder, and bearing on the under surface or margin the clustered or separate sporangia or spore-cases.

Synopsis of the Genera.

SUBORDER I. **POLYPODIA'CEÆ.** (THE TRUE FERNS.)

Sporangia collected into various kinds of clusters called *sori*. Each sporangium pedicelled and encircled by an elastic jointed ring, by the breaking of which the sporangium is burst and the spores discharged. Sori sometimes covered by an *indusium*.

1. **Polypo'dium.** Fruit-dots on the back of the frond near the ends of the veins. *No indusium.* Veins free. (See Fig. 231, Part I.)
2. **Adian'tum.** Fruit-dots *marginal*, the edge of the frond being reflexed so as to form an indusium. *Midrib of the pinnules close to the lower edge or altogether wanting.* Stipe *black and shining*. All the pinnules distinct and generally minutely stalked. Veins free.
3. **Pte'ris.** Fruit-dots *marginal*. Indusium formed by the reflexed edge of the frond. Midrib of the pinnules in the centre and prominent. Veins free. Stipe light-coloured. (See Fig. 262.)
4. **Pellæ'a.** Fruit-dots *marginal*, covered by a broad indusium, formed by the reflexed margin of the frond. Small ferns with once- or twice-pinnate fronds, the fertile ones very much like the sterile, but with narrower divisions. Stipe shining, purple or brown.

5. **Asple'nium.** Fruit-dots elongated, on veins on the back of the pinnules, *oblique to the midrib, but only on the upper side of the vein. Indusium attached to the vein by one edge*, the other edge free. Veins free.

6. **Woodwardia.** Fruit-dots elongated, on cross-veins *parallel to the midrib*, forming a chain-like row on each side of the latter. Indusium as in the last. *Veins reticulated.*

7. **Scolopen'drium.** Fruit-dots elongated, *occurring in pairs on contiguous veinlets*, the free edges of the two indusia facing each other, so that the sori appear to be single, with an indusium split down the centre. Veins free. *Frond simple, ribbon-shaped*, about an inch broad, generally wavy-margined.

8. **Camptoso'rus.** Fruit-dots elongated, those near the base of the midrib double, as in Scolopendrium; others single, as in Asplenium. *Fronds simple*, $\frac{1}{2}$ or $\frac{3}{4}$ of an inch wide at the heart-shaped base, and tapering into a long and narrow point; growing in tufts on limestone rocks, and commonly rooting at the tip of the frond, like a runner. Veins reticulated.

9. **Phegop'teris.** Fruit-dots roundish, on the back (not at the apex) of the veinlet, rather small. *Indusium obsolete or none.* Veins free. *Fronds triangular in outline*, in one species twice-pinnatifid, with a winged rhachis, and in the other in three petioled spreading divisions, the divisions once- or twice-pinnate.

10. **Aspid'ium.** Fruit-dots round. Indusium evident, flat, orbicular or kidney-shaped, fixed by the centre, opening all round the margin. Veins free. Generally rather large Ferns, from once- to thrice-pinnate. (See Fig. 264.)

11. **Cystop'teris.** Fruit-dots round. Indusium not depressed in the centre, but rather raised, attached to the frond not by the centre, but by the edge partly under the fruit-dot, and generally breaking away on the side towards the apex of the pinnule, and becoming reflexed as the sporangia ripen. Fronds slender and delicate, twice- or thrice-pinnate.

12. **Struthiop'teris.** Fertile frond much contracted and altogether unlike the sterile ones, the latter very large and growing in a cluster with the shorter fertile one in the centre. Rootstock very thick and scaly. Fertile fronds simply pinnate, the margins of the pinnæ rolled backwards so as to form a hollow tube containing the crowded sporangia. Very common in low grounds.

13. **Onocle'a.** Fertile and sterile fronds unlike. (See Figs. 266, 267, 268, 269, and accompanying description.)

14. **Dickso'nia.** Fruit-dots round, *very small, each on a recurved toothlet* on the upper margin of the lobes of the pinnules, usually one to each lobe. Sporangia on an elevated globular receptacle, and enclosed in a cup-shaped indusium open at the top and partly adherent to the reflexed toothlet of the frond. Fronds minutely glandular and hairy, 2–3 feet high, ovate-lanceolate in outline, pale green, very thin, without chaff,

SUBORDER II. OSMUNDA'CEÆ.

Sporangia naked, globular, pedicelled, *reticulated*, opening by a vertical slit.

15. **Osmun'da.** Fertile fronds or *fertile portions* of the frond much contracted, bearing naked sporangia, which are globular, short-pedicelled, and opening by a *vertical* slit to discharge the spores. Frond tall and upright, once- or twice-pinnate, from thick rootstocks.

SUBORDER III. OPHIOGLOSSA'CEÆ.

Sporangia naked, *not reticulated*, opening by a horizontal slit. *Fronds not circinate in the bud.*

16. **Botrych'ium.** Sporangia in compound spikes, *distinct*, opening by a horizontal slit. Sterile part of the frond compound. Veins free. (See Figs. 270 and 271.)
17. **Ophioglos'sum.** Sporangia *coherent* in 2 ranks on the edges of a simple spike. Sterile part of the frond simple. Veins reticulated.

1. POLYPO'DIUM, L. POLYPODY.

P. vulga're, L. Fronds evergreen, 4–10 inches long, deeply pinnatifid, the lobes obtuse and obscurely toothed. Sori large.—Common on shady rocks.

2. ADIAN'TUM, L. MAIDENHAIR.

A. peda'tum, L. Stipe upright, black and shining. The frond forked at the top of the stipe, the two branches of the fork recurved, and each bearing on its inner side several slender spreading divisions, the latter with numerous thin pinnatifid pinnules which look like the *halves* of pinnules, owing to the midrib being close to the lower edge. Upper margin of the pinnules cleft.—Common in rich woods.

3. PTE'RIS, L. BRAKE. BRACKEN.

P. aquili'na, L. Stipe stout and erect. Frond large and divided into 3 large spreading divisions at the summit of the stipe, the branches twice-pinnate, the pinnules margined all round with the indusium.—Common in thickets and on dry hillsides.

4. PELLÆ'A, Link. CLIFF-BRAKE.

1. **P. gra'cilis,** Hook. Fronds 3–6 inches high, slender, of few pinnæ, the lower ones once- or twice-pinnatifid into 3–5 divisions,

those of the fertile fronds narrower than those of the sterile ones. Stipe polished, *brownish*, darker at the base.—Shady limestone rocks; not common.

2. **P. atropurpu'rea,** Link. Larger than the last, 6–15 inches high, the stipe *dark-purple* and shining. Frond pale, once- or (below) twice-pinnate, the divisions broadly linear or oblong (or the sterile sometimes oval), stalked at the base. Stipes clustered.—Dry rocks.

5. ASPLE'NIUM, L. Spleenwort.

1. **A. Trichom'anes,** L. A very delicate little fern growing in tufts on shaded cliffs. Fronds 3–6 inches long, linear in outline, pinnate, the little pinnæ oval and unequal-sided, about $\frac{1}{5}$ of an inch long. The stipes thread-like, purplish-brown and shining. This species is evergreen.

2. **A. thelypteroi'des,** Michx. Fronds 2–3 feet high, *pinnate*, the pinnæ linear-lanceolate in outline, 3–5 inches long, *deeply pinnatifid*, each of the crowded lobes bearing 3–6 pairs of oblong fruit-dots.—Rich woods.

3. **A. angustifo'lium,** Michx. Fronds simply pinnate, somewhat resembling Aspidium acrostichoides, *but very smooth and thin*, and larger. Pinnæ crenulate, short-stalked. Fruit-dots linear, crowded.—Rich woods; not common.

4. **A. Filix-fœ'mina,** Bernh. Fronds 1–3 feet high, broadly lanceolate in outline, *twice-pinnate*, the pinnæ lanceolate in outline, and the pinnules confluent by a narrow margin on the rhachis of the pinna, doubly serrate. *Indusium curved*, often shaped something like a horse-shoe, *owing to its crossing the vein and becoming attached to both sides of it.*—Rich woods.

6. WOODWARD'IA, Smith. Chain Fern.

W. Virgin'ica, Smith. Fronds 2–3 feet high, pinnate; pinnæ lanceolate, pinnatifid. Veins forming a single row of meshes next the midrib.—Wet swamps.

7. SCOLOPEN'DRIUM, Smith. Hart's Tongue.

S. vulga're, Smith. Frond simple, bright green, a foot or more in length, and an inch or more in width.—Shaded ravines and limestone cliffs; not very common.

8. **CAMPTOSO'RUS**, Link. WALKING-LEAF.

C. rhizophyl'lus, Link. A curious little fern, growing in tufts on shaded limestone rocks. Frond simple, with a very long narrow point.—Not very common.

9. **PHEGOP'TERIS**, Fée. BEECH FERN.

1. **P. polypodioi'des**, Fée. Fronds triangular, longer than broad, 4–6 inches long, hairy on the veins, twice-pinnatifid, *the rhachis winged.* The pinnæ sessile, linear-lanceolate in outline, *the lowest pair deflexed and standing forwards.* Fruit-dots small and *all* near the margin. Stipes rather longer than the fronds, from a slender, creeping rootstock.—Apparently not common, but growing in rich woods near Barrie, Ont.

2. **P. hexagonop'tera**, Fée. Fronds triangular, generally broader than long, 7–12 inches broad. Pinnæ lanceolate; the lowest very large, their divisions elongated and pinnatifid, the basal divisions decurrent on the main rhachis and forming a many-angled wing. Fruit-dots not exclusively near the margin. —Rich woods.

3. **P. Dryop'teris**, Fée. Fronds broadly triangular in outline, primarily divided into 3 triangular spreading petioled divisions, smooth, the three divisions once- or twice-pinnate. Fronds from 4 to 6 inches wide. Fruit-dots near the margin.—Rich woods; common. Whole plant delicate, and light green in colour.

10. **ASPID'IUM**, Swartz. SHIELD FERN. WOOD FERN.

* *Stipes not chaffy.*

1. **A. thelyp'teris**, Swartz. Fronds tall and narrow, lanceolate in outline, pinnate, the pinnæ deeply pinnatifid, nearly at right angles to the rhachis, linear-lanceolate in outline, *the margins of the lobes strongly revolute in fruit.* Stipe over a foot long, and usually longer than the frond.—Common in low, wet places.

2. **A. Noveboracen'se**, Swartz. *Fronds much lighter in colour than the preceding,* tapering towards both ends, pinnate, the pinnæ deeply pinnatifid, much closer together than in No. 1, and not at right angles with the rhachis. Veins simple. Lower pinnæ short and deflexed.—Swamps.

* * *Stipes chaffy.*

3. **A. spinulo'sum,** Swartz. Stipes *slightly* chaffy or scaly. Fronds large, ovate-lanceolate in outline, *twice-pinnate*, the pinnules deeply pinnatifid (*nearly pinnate*), and spiny-toothed. Pinnæ triangular-lanceolate in outline. The variety **intermedium,** which is very common in Canadian woods, has the few scales of the stipe pale brown *with a dark centre*, and *the lower pinnæ unequal-sided.* Var. **Boottii** has the scales of the stipe pale brown, the frond elongated-oblong or elongated-lanceolate and pinnules less dissected.

4. **A. cristá'tum,** Swartz. Stipes chaffy with broad scales. Fronds large, linear-lanceolate in outline, once-pinnate, the pinnæ deeply pinnatifid, the upper ones triangular-lanceolate in outline, the lower considerably broader, the lobes cut-toothed. Fruit-dots large and conspicuous, *half way between the midrib of the lobe and the margin.*—Swamps.

5. **A. Goldia'num,** Hook. A fine fern, the large fronds growing in a circular cluster from a chaffy rootstock. Frond ovate or ovate-oblong in outline, once-pinnate, the pinnæ deeply pinnatifid, 6–9 inches long, *broadest in the middle*, the lobes slightly scythe-shaped, finely serrate. Fruit-dots large, *near the midrib of the lobe.*—Rich moist woods.

6. **A. margina'le,** Swartz. Stipes very chaffy at the base. Fronds ovate-oblong in outline, twice-pinnate, the pinnæ lanceolate in outline, broadest above the base. Pinnules crenate-margined. *Fruit-dots large, close to the margin.*—Rich woods, mostly on hill-sides.

7. **A. acrostichoi'des,** Swartz. (See Figs. 264 and 265, and accompanying description.)—Rich woods, everywhere.

8. **A. Lonchi'tis,** Swartz. Not unlike No. 7, but the fronds are *narrower and longer*, more rigid and with hardly any stipe. Pinnæ densely spinulose-toothed.—Apparently not common, but plentiful in rocky woods west of Collingwood, Ont.

11. **CYSTOP'TERIS,** Bernhardi. BLADDER FERN.

1. **C. bulbif'era,** Bernh. Frond large (1–2 feet), narrow and very delicate, twice-pinnate, the pinnæ nearly at right angles to

the rhachis. Rhachis and pinnæ *usually with bulblets beneath.* Pinnules toothed.—Shady, moist ravines.

2. **C. fra'gilis,** Bernh. Frond only 4–8 inches long, with a stipe of the same length, twice- or thrice-pinnate. *Rhachis winged.*—Shady cliffs.

12. STRUTHIOP'TERIS, Willd. OSTRICH FERN.

S. German'ica, Willd. (*Onoclea Struthiopteris,* Hoff.) Sterile fronds with the lower pinnæ gradually much shorter than the upper ones. Pinnæ deeply pinnatifid.—Common in low, wet grounds along streams.

13. ONOCLE'A, L. SENSITIVE FERN.

O. sensib'ilis, L. (See Figs. 266, 267, 268 and 269, and accompanying description.)—Common in wet grounds along streams.

14. DICKSO'NIA, L'Her. DICKSONIA.

D. punctilo'bula, Kunze. Pleasantly odorous.—Moist, shady places.

15. OSMUN'DA, L. FLOWERING FERN.

1. **O. rega'lis,** L. (FLOWERING FERN.) Fronds twice-pinnate, *fertile at the top,* very smooth, pale green. Sterile pinnules oblong-oval, finely serrate towards the apex, 1–2 inches long. either sessile or short-stalked, usually oblique and truncate at the base.—Swamps, along streams and lake-margins.

2. **O. Claytonia'na,** L. Fronds large, once-pinnate, pale green, densely white-woolly when unfolding from the bud, *with fertile pinnæ among the sterile ones.* Pinnæ deeply pinnatifid, the lobes entire.—Low grounds.

3. **O. cinnamo'mea,** L. (CINNAMON FERN.) *Fertile fronds distinct from the sterile ones,* contracted, twice-pinnate, covered with cinnamon-coloured sporangia. Sterile fronds rusty-woolly when young, smooth afterwards, once-pinnate, the pinnæ deeply pinnatifid. The long, sterile fronds in a cluster, with the fertile ones in the centre.—Low grounds.

16. BOTRYCH'IUM, Swartz. MOONWORT.

1. **B. Virgin'icum,** Swartz. (See Figs. 270 and 271, and accompanying description.)—Rich woods everywhere.

2. **B. lunarioi'des,** Swartz, is occasionally found. It is easily distinguished from No. 1 by the sterile portion of the frond being long-petioled instead of sessile.

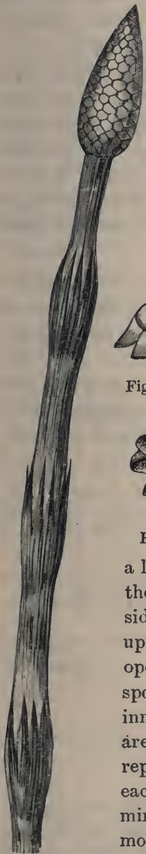

Fig. 272.

17. OPHIOGLOS'SUM, L. ADDER'S TONGUE.

O. vulga'tum, L. Sterile part of the frond ovate or elliptical-oblong, 2–3 inches long, rather fleshy, sessile, near the middle of the stalk; the latter 6–12 inches high.—Bogs and grassy meadows.

ORDER CVIII. EQUISETA'CEÆ. (HORSETAIL FAMILY.)

The only genus of the Order is

EQUISE'TUM, L. HORSETAIL. SCOURING RUSH

Fig. 273.

Fig. 274.

Fig. 272 is a view of the fertile stem of **Equise'tum arvense,** the COMMON HORSETAIL, of about the natural size. It may be observed early in spring almost anywhere in moist sandy or gravelly soil. It is of a pale brown colour, and in place of leaves there is at each joint a sheath split into several teeth. At the summit of the stem is a sort of conical catkin, made up of a large number of six-sided bodies, each attached to the stem by a short pedicel. Each of these six-sided bodies turns out on examination to be made up of six or seven sporangia or spore-cases, which open down their inner margins to discharge their spores. Figs. 273 and 274 are enlarged outer and inner views of one of them. The spores themselves are of a similar nature to those of the Ferns, and reproduction is carried on in the same manner; but each spore of the Horsetail is furnished with four minute tentacles which closely envelope it when moist, and uncoil themselves when dry. The use of these tentacles is doubtless to assist in the escape and dispersion of the spores.

The fertile stems will have almost withered away by the time the sterile ones appear. These latter are of the same thickness as the fertile ones, but they are very much taller and are green in colour. Observe, also, the grooving of the sterile stem, and the whorls of 4-angled branches produced at the nodes.

E. limo'sum, L., produces its spores in the summer. The stems are all of one kind, or at all events are produced contemporaneously, and after fruiting produce upright branches. They are, also, *slightly* many-furrowed. The sheaths have commonly about 18 dark-brown stiff short teeth.—In shallow water.

The two species just described are annual; the following are evergreen, surviving the winter. The terminal spike is tipped with a small rigid point.

E. hyema'le, L. (SCOURING RUSH.) Stems stout and tall. Sheaths elongated, with a black girdle above the base, and about 20 narrow linear teeth, 1-keeled at the base, and with awl-shaped deciduous points.—Wet banks.

E. variega'tum, Schleicher. Stem *slender*, in tufts, with 5–10 grooves, ascending, 6–18 inches high. Sheaths green, variegated with black above, 5–10-toothed.—Shores and river-banks.

E. scirpoi'des, Michx. Stems *slender*, *very numerous in a tuft*, filiform, 3–6 inches high, curving, mostly 6-grooved. *Sheaths 3-toothed.*—Wooded hill-sides.

ORDER CIX. LYCOPODIA'CEÆ. (CLUB-MOSS F.)

Chiefly moss-like plants; often with long running and branching stems, the sporangia solitary in the axils of the mostly awl-shaped leaves.

Synopsis of the Genera.

1. **Lycopo'dium.** *Spore-cases of one kind only,* in the axils of the upper awl-shaped leaves; 2-valved, kidney-shaped. Chiefly evergreen plants. (See Part I., sections 332–335.)
2. **Selaginel'la.** *Spore-cases of two kinds:* one like those of Lycopodium, containing very minute spores, the other 3–4-valved, and containing a few large spores. The two sorts intermingled, or the latter in the lower axils of the spike. Little moss-like tufted evergreens.

1. LYCOPO'DIUM, L., Spring. CLUB-MOSS.

1. **L. luci'dulum**, Michx. Stems 4–8 inches long, tufted, 2 or 3 times forking. The leaves forming the spike not different from the others on the stem; all spreading or reflexed, sharp-pointed, serrulate, dark green and shining.—Cold, moist woods.

2. **L. anno'tinum**, L. Stems creeping, 1–4 feet long. Branches 4–9 inches high, once- or twice-forked. Spike sessile, the leaves of it yellowish and scale-like, ovate or heart-shaped, the others spreading or reflexed, rigid, pointed, nearly entire, pale green.—Cold woods.

3. **L. dendroi'deum**, Michx. (GROUND PINE.) Rootstock creeping underground, nearly leafless. Stems much resembling little hemlocks, 6–9 inches high; numerous fan-like spreading branches with shining lanceolate entire leaves. Spikes nearly as in No. 2, 4–10 on each plant.—Moist woods.

4. **L. clava'tum**, L. (CLUB-MOSS.) Stem creeping or running extensively. *Spikes mostly in pairs*, raised on a slender peduncle (4–6 inches long). Leaves linear, awl-shaped, *bristle-tipped.*—Dry woods.

5. **L. complana'tum**, L. Stem creeping extensively. *Branches flattened*, forking above, the branchlets crowded. Leaves awl-shaped, small, in 4 ranks.—Dry woods; mostly with evergreens.

2. SELAGINEL'LA, Beauv., Spring.

S. rupes'tris, Spring. A little moss-like evergreen, growing on exposed rocks in dense tufts 1–3 inches high. Leaves awl-shaped, with a grooved keel, and tipped with a bristle. Spikes 4-cornered.

INDEX.

The names of the Orders, Classes, and Divisions are in large capitals; those of the Sub-orders in small capitals. The names of Genera, as well as popular names and synonyms, are in ordinary type.